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STAFF APPRAISAL REPORT

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

April 29, 1985

Transportation Division
Projects Department
East Asia and Pacific Regional Office

CURRENCY EQUIVALENTS

US$1	=	W 860 (as of April 1985)
US$1.16	=	W 1,000
US$1 million	=	W 860 million
US$1,162	=	W 1 million

FISCAL YEAR

January 1 - December 31

WEIGHTS AND MEASURES

1 meter (m)	= 3.2808 feet (ft)
1 kilometer (km)	= 0.62 mile (mi)
1 square kilometer (km^2)	= 0.3861 square miles (sq mi)
1 hectare (ha) = 0.01 km^2	= 2.4711 acres (ac)
1 kilogram (kg)	= 2.2046 pounds (lbs)
1 metric ton (m ton)	= 2.204.6226 pounds (lbs)
	1.1023 short tons (sh tons or 2,000 lbs)
	0.9842 long tons (lg ton or 2,240 lbs)

PRINCIPAL ABBREVIATIONS AND ACRONYMS USED

BPR	-	Bureau of Public Roads
CTC	-	Centralized Traffic Control
EPB	-	Economic Planning Board
GOK	-	Government of Korea
KHC	-	Korea Highway Corporation
KMPA	-	Korea Maritime and Ports Authority
KNR	-	Korean National Railroad
MOC	-	Ministry of Construction
MOER	-	Ministry of Energy and Resources
MOF	-	Ministry of Finance
MOHA	-	Ministry of Home Affairs
MOT	-	Ministry of Transportation
SMESRS	-	Seoul Metropolitan Electric Suburban Rail System
TCC	-	Transport Coordination Committee

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

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This report is based on the findings of a February 1985 appraisal mission to Korea comprising Messrs. A. F. Ballereau (Economist) and J. Taylor (Consultant). Messrs. B. K. Thomas (Financial Analyst), J. Yenny (Economist) and E. Karman (Engineer) also contributed to the report.

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CHART

1. Korea National Railways (KNR): WB 24503

MAPS

IBRD Korea Transport Network: 13133R1
IBRD Korea Railway Network: 18758

KOREA

SEOUL - BUSAN CORRIDOR PROJECT

Loan and Project Summary

Borrower:	Republic of Korea
Amount:	$67 million equivalent
Terms:	Repayable in 15 years with 3 years of grace, at the standard variable rate
Project Description:	The basic objective of the project is to assist the Korean National Railways (KNR) to increase transport efficiency and capacity of rail services in the Seoul-Busan Corridor. The loan funds would help finance part of a Management Improvement Program to be implemented over the 1985-88 period. KNR's Program includes: (a) institutional and policy measures aimed mainly at ensuring long-term economic and financial viability of the railways by further improving services that are most profitable; (b) measures to improve intermodal complementarity and railway competitiveness and to prepare the ground for a high speed train, a major capacity increase to be introduced in the 90s; and (c) capacity expansion through resignalling and central traffic control between Suweon-Daegu on the Seoul-Busan Corridor, and related rolling-stock/equipment, providing over one-third more trains more safely and at faster speed. The proposed project comprises the resignalling and central traffic control components of item (c), as well as associated technical assistance and training. The project has a high economic return and the signalling overhaul is overdue.
Risks:	Risk for this type of project is in traffic forecasting; but in Korea's rapidly growing economy actual passenger traffic has typically exceeded forecasts in the past. Sensitivity analysis shows that a satisfactory return would be achieved even with substantially lower traffic growth.

Project Cost:	Local	Foreign	Total
	(US$ million)		
Signalling	17.0	43.6	60.6
Power Supply	3.1	3.3	6.4
Communications	8.9	9.5	18.4
Equipment Rooms	4.4	-	4.4
Supervision	3.8	-	3.8
Coaches	51.1	-	51.1
Materials, etc.	10.0	-	10.0
Base Cost	98.3	56.4	154.7
Physical contingencies	4.9	0.6	5.5
Price contingencies	8.1	10.0	18.1
Total Project Cost	111.3	67.0	178.3

Identifiable duties and taxes are about $23.4 million. Total project cost net of duties and taxes is about $154.9 million.

Financing Plan:	Local	Foreign	Total	%
	(US$ million)			
World Bank loan	-	67.0	67.0	38
The Government	111.3	-	111.3	62
Total Financing	111.3	67.0	178.3	100

Estimated Disbursements: Bank FY	1986	1987	1988	1989
Annual	2.8	20.3	14.9	29.0
Cumulative	2.8	23.1	38.0	67.0

Rate of Return: 41%

Staff Appraisal Report: No. 5570-KO dated April 29, 1985

Maps: No. IBRD 13133R1 and 18758

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

I. TRANSPORT SECTOR

A. Geographic and Economic Setting

1.01 The Republic of Korea has a land area of 98,500 sq km. About 70% of the land area is mountainous and agriculture is confined to about 22,600 sq km, or 23% of the total area, mainly in the river valleys, lower hillsides and coastal plains. The climate is seasonal with very cold dry winters and hot humid summers. Annual rainfall averages 800 mm to 1,400 mm with about 60% falling between June and September. The land mass is drained by a well developed river system with seasonal variations in flow which give rise to frequent flooding. The rugged terrain, extensive river system and severe winter climate make the construction of transport facilities, particularly roads, difficult and costly.

1.02 The population is presently estimated at about 40 million and is growing at an annual rate of 1.7%. Population density is estimated at 388 per sq km of total area or 1,702 per sq km of agricultural land. Urban population is estimated to be growing at an annual rate of 4.6% and has increased from 40.7% of the total in 1970 to 55.9% in 1982. The increasing urban population has created significant transport demand in the areas around the cities and industrial centers and between them; particularly in the Seoul - Busan (Gyeongbu) Corridor.

1.03 Korea's export-led industrialization has been among the most successful examples of economic development in recent history. During 1962-78, real GNP grew by 10% p.a. and per capita income more than tripled in real terms. Coupled with industrialization and urbanization, major developments and changes in the transportation sector complemented and supported the transformation of Korea's economy. Passenger traffic tripled between 1964 and 1971 and tripled again by 1982; freight increased nine times and five times respectively during the same periods.

B. The Transport System

1.04 Throughout much of the past 20 years, the transport system has been strained by the demands of rapid growth and it has required massive public sector investments in transport infrastructure. The Government has been allocating up to 23% of its total capital expenditure to expand and modernize transport infrastructure from 1967 to 1977 tapering down to about 15% in the Fourth (1977-81) and Fifth Plans (1982-86). Investments have been concentrated on the Seoul-Busan axis where most industrial development is taking place and on other corridors serving the northeastern and southeastern parts of Korea.

1.05 Substantial changes in the modal distribution of traffic are illustrated by traffic statistics for the 1961 to 1982 period (Tables 1.1 and 1.2). Freight traffic moving by rail, although showing growth in absolute terms, fell from 88% of total ton-km to 37%, while the road and coastal shipping shares increased from 8% to 36% and from 4% to 27%, respectively. For passenger traffic, the rail share of total passenger-km fell from 53% to 22% over the same period, while the road share increased from 45% to 75%. These changes reflect both the economic advantages of the various modes and the different growth rates experienced between industries served, as rail and coastal shipping increasingly were concentrated on long distances and bulk commodities while road transport handled the short distances and more general cargo. In addition, rapidly expanding personal consumption generated large increases in personal travel. This travel is made mainly by public transport such as express trains and buses, since high taxation of private cars and gasoline has limited motorization to a level significantly below that of other countries with income levels comparable to those of Korea.

1.06 The Government of Korea's (GOK) basic objective in the past has been to increase the capacity of the system in line with projected traffic growth and to avoid major bottlenecks. This objective has been largely achieved. The present system is reasonably balanced and there is little uneconomic allocation of traffic among the various modes. Investments in transportation have been linked to broader concerns in Korea's spatial and economic planning. For example, considerable efforts have been made to develop new industrial complexes in coastal areas, to take advantage of Korea's natural potential in harbors and to exploit low-cost coastal shipping while avoiding excessive congestion on road and rail. Similarly, in its efforts to ensure that appropriate development priorities were reflected in the allocation of scarce transportation means among the competing claims, the Government has maintained fairly tight regulations in the sector, with a restrictive licensing system and administered pricing for all transport activities. These tight regulations which have not always enhanced efficiency in transport, are under review.

1.07 Large investments in transportation infrastructure have been complemented by a considerable effort to improve the efficiency of the transportation system, through the establishment and strengthening of institutions to plan, construct, maintain and operate the facilities and services. In the public sector, institutions such as the Korean National Railroad (KNR), the Bureau of Public Roads (BPR) in the Ministry of Construction (MOC), the Korea Highway Corporation (KHC), and the Korea Maritime and Port Administration (KMPA) have been established or strengthened in many instances with increasing financial and managerial responsibility as semi-autonomous public corporations. In the private sector, a highly efficient contractor system has evolved for civil works which reflects both the insistence on competitive bidding in the award of contracts as a matter of policy, and the large volume of construction that has been carried out in Korea during the past 20 years. There are now some 500 firms capable of handling a broad range of public works. Furthermore, with Government encouragement, the major construction firms have successfully expanded their construction activities overseas; in 1981, Korean contractors won overseas contracts valued at over US$13 billion, though due to adverse international conditions, new orders dwindled to less than half this total by 1984.

1.08 Details on the last four Five-Year Investment Plans (1962-81) together with the Bank's involvement in the transport sector are given in Annex 1.

C. Transport Sector Objectives and Issues in the 1980s

1.09 Objectives. The Government's main goals for the transport sector as stated in the Fifth Five-Year Economic and Social Development Plan (FFYP) (1982-86) are to: (a) selectively increase transport capacity by modernizing equipment and optimizing investments in the sector; (b) enhance transport efficiency by improving intermodal traffic allocation and conserving energy; and (c) strengthen maintenance activities.

1.10 These FFYP goals are appropriate and timely. Recovery from the recession of 1979/81 is now completed, with an economic growth rate over 9% in 1984 and inflation down to 3% p.a. Growth for the medium-term is likely to be high, although more modest than during the 1970s. The recent economic slowdown has provided a two-fold lesson for the transportation sector. On the one hand, the timing of investments needed to sustain further improvements in transport capacity and quality of service will have to be closely linked to the growth of traffic for each mode. On the other hand, the capacity of the public sector to finance the necessary upgrading and expansion of infrastructure and facilities in transportation will be constrained by foreign borrowing limitations.

1.11 For the medium term, the Fifth Five Year Plan projects a GNP growth rate of 7.6% p.a. over the period 1982-86, with a corresponding increase in transport demand estimated at about 47 billion passenger-km and 10 billion ton-km, respectively 50% and 30% above fourth plan period outcomes (Tables 1.3 and 1.4). Investments in transportation (public and private) are expected to increase by about 45% and remain at close to 14% of the total planned outlay as in the fourth plan. They will amount to some US$16.3 billion, calculated at 1980 prices and exchange rates. However, investments in subways and aviation will absorb a larger fraction of the total as will road vehicles and ships. Hence, real investment in the railway system, road and port infrastructure would increase by less than 20% above fourth plan outlays (Table 1.5).

1.12 Issues. A Bank transport sector mission reviewed the transport investments proposed in the FFYP and identified the policy and institutional issues impeding efficiency in the sector. The mission concluded (in the Transport Sector Issues Survey Report No. 4423-KO dated December 27, 1983) that, although most of the transport investments proposed under the Plan pursue development priorities which are appropriate, considerably more could be done to increase the productivity of existing facilities and equipment. With the increasingly complex traffic patterns and higher traffic densities, the growing requirements for maintenance of the expanded system, and the need to conserve energy, the mission foresaw an even greater need to maximize efficiency and use of limited investment outlays in this capital intensive sector. The mission recommended focussing on planning, regulation and pricing, and energy conservation as the three main areas requiring specific

attention in the current more demanding economic environment. Details are given in Annex 2. Noteworthy are measures introduced under the 1984 Highway Sector Project (Loan 2392-KO) to improve (a) road investment planning; (b) energy efficiency in transport; and (c) regulation and pricing in road transport. Progress so far is satisfactory. The proposed project will help in increasing utilization of existing rail capacity, improve efficiency and stimulate inter-modal complementarity.

D. Bank's Role

1.13 It is expected that the Bank's policy dialogue would be strengthened in future years through the increasing emphasis being given to a sector and subsector approach in transport lending in Korea. The recently approved Highway Sector Project will deepen and broaden our involvement in the road subsector by extending assistance for the Ministries of Construction (MOC), of Home Affairs (MOHA), of Transport (MOT) and of Energy and Resources (MOER). This involvement provides the Bank with an opportunity to improve coordination between those agencies and to strengthen the basis for another possible highway subsector loan. Similarly, a recently completed ports container site location study examined several alternatives where container facilities could be developed to handle the nation's traffic through the next decade and may lead to a port subsector loan. For railways, the Bank has traditionally made sector type loans, financing time slices of KNR's investment plans with the sixth and seventh railway projects covering respectively 1978/79 and 1980/81 investments.

1.14 Besides these subsector operations, we are assisting the Government in developing multimodal projects. The first was the Coal and Cement Distribution Project (Loan 2267-KO) approved in 1983, involving railways, ports and inland terminals. It will be followed by projects directed toward increasing the capacity of the system in certain high priority areas and corridors rather than expanding the system as a whole. The Bank is assisting in developing an integrated modal study to meet the very high transport demand in the suburban areas of Seoul (Kyeonggi multimodal transport study) where a dense network of facilities are needed. The complementarity of the various modes will be promoted by developing interconnecting terminals to optimize the use of this suburban transport network. Another multi-modal transport study carried out from 1983 to 1985 concerns the Seoul-Busan transport corridor and the feasibility of a high speed rail line between Seoul and Busan. The proposed project represents a first step to increase capacity; subsequent steps might include a high speed train, which would run on a separate, dedicated track, and further road transport improvements. A third study to follow later is being discussed with Government covering the southeast coastal region from Suncheon to Pohang, where most heavy industries are concentrated, and new developments are being considered at the Kwang-yang Bay.

II. RAILWAY SUBSECTOR

A. KNR Organization and Management

2.01 The Korean National Railroad (KNR) was established on December 31, 1961 as a quasi-business enterprise owned by the Government of the Republic of Korea and controlled by the Ministry of Transportation. The initial capital comprised railroad assets, net of certain liabilities, transferred at estimated fair value at January 1, 1962. Actual title to real property vests in the Government of the Republic of Korea. By statute, KNR has the right of use or disposition of property either originally transferred to it or later acquired, and the right to receive rental or sale proceeds. Land may be appropriated by the Government and dedicated to certain public uses without compensation to KNR.

2.02 The Administrator of KNR is appointed by the Government to assume the function of General Manager. The Administrator is assisted by a Deputy-Administrator who comes from within KNR and is in charge of the day-to-day operations. Chart 24503 shows KNR's organization. KNR's management enjoys reasonable day-to-day managerial freedom.

2.03 It is planned that in 1987 KNR will be converted to a public corporation. It would be empowered to incur debt, fix the emoluments of its staff and control its own budget. Management consultants funded by the Bank under the Fifth Railway Project (1101-KO) have advised on the steps necessary to effect the transition and on the organizational changes to be adopted, and an implementation program has been designed and is now in progress.

B. Staffing and Training

2.04 KNR presently employs about 40,000 staff of whom about 34,500 are permanent employees with Government civil service status. The rest comprise semi-permanent and temporary personnel used in workshops and on track works on a seasonal basis. Staff productivity in terms of traffic units per employee has been rising in recent years and is now one of the highest in the world; it reached 823,000 units per employee in 1983 as against some 500,000 typical in European railways. This is due partly to the dense urban and intercity passenger travel and heavy bulk mineral traffic and partly to KNR's staff training, discipline and professionalism.

2.05 Training facilities comprise a Railroad School where courses are offered to recruits at both high school and college levels, and a training center with regional branches at which various types of training (including management development) are provided to current staff. Previous Bank projects have financed equipment and materials for practical training, and overseas training in specialized subjects for selected staff.

C. Accounting and Audit

2.06 KNR operates a double-entry accrual based accounting system. Its financial statements are prepared according to generally accepted accounting principles applicable in the United States.[1/]

2.07 KNR's audit arrangements consist of a review (according to standards established by the American Institute of Certified Public Accountants) performed by an independent Korean public accounting firm acceptable to the Bank. The reports, which under previous loan agreements are to be received by the Bank within six months of the financial yearend, have been tardy in the past but are now timely.

D. Railway Facilities

2.08 The system consists of 3,100 route-km of standard gauge (1.435 m) and 47 km of narrow gauge (0.76 m) lines; 760 km are double track and the remainder single track (Map 13134). The major sections of double track line are Gyeongbu (Seoul-Pusan, 491 km) and Chungbuk (Chochiweon - Bongyang, 110 km). 428 route-km are electrified.

2.09 Centralized traffic control (CTC) has been installed in the Seoul urban area and on the heavily trafficked electrified single line Seoul-Jecheon. Under the Seventh Project (Loan 1836-KO), CTC is being installed on the section Yeongju-Gyeongju of the Jung Ang line (about 164 km deferred from the sixth railway project) and the Tae Baeg line (about 107 km). The Gyeongbu line, which is the subject of the proposed project, has an automatic block system, while on other lines electric interlocking or token block systems are used. For safety, an automatic train stopping system is being installed.

2.10 KNR's motive power fleet at the end of 1983 comprised 449 diesel and 90 electric locomotives and 113 diesel rail cars. 320 electric railcars provide commuter services. The fleet is modern and in good condition. Rolling stock comprises about 2,100 passenger cars, and about 16,000 freight cars.

2.11 KNR maintains a number of workshops, of which the main ones are at Seoul (electric locomotives, diesel and electric railcars, passenger cars and freight cars), Yeongdeungpo (steam locomotives, passenger cars and freight cars), Incheon (passenger cars and freight cars), and Busan (diesel locomotives, passenger cars and freight cars). Steam locomotives have been completely phased out. A new rolling stock workshop has been constructed at Daejeon; the freight car shop is just completed and the passenger car shop is in use.

1/ With the major exception of the revaluation of assets, which is incorporated in KNR's primary accounting records.

E. Traffic

2.12 In 1984 KNR's intercity passenger services carried 165 million passengers an average distance of 108 km, totaling 17.8 billion passenger-km. In recent years, intercity traffic has declined from a peak reached in 1980. The total however conceals a shift of traffic from ordinary trains to expresses, whose ridership increased from 40 million in 1979 to over 55 million in 1984, an annual rate of 7%. The average journey distance also increased. Suburban traffic on the Seoul area SMESRS has also been growing at about 7% p.a. For the future, growth of express passenger and SMESRS is projected to continue at 6% and 7% respectively (passenger-km terms), while ordinary traffic will continue to decline. KNR passenger traffic statistics are at Tables 2.1-2.3.

2.13 Freight traffic has grown at average annual rates of 6.7% in tons and 6% in tons-km since 1966. Major commodities which contributed to these increases were coal and cement. Bulk commodities such as these and ore, oil, fertilizer, and grain accounted for over 80% of KNR's total freight ton-km in 1984, up from 69% in 1966. Apart from some military and KNR's own transport, the remainder consists mainly of general cargo. In 1984, freight traffic totalled 53.7 million tons and the average freight haul was 230 km. KNR freight statistics are at Table 2.4.

F. Investment Plan

2.14 KNR plans its investments on a five year cycle coterminuous with the national five year plan; the present version covers the period 1982-1986. According to this plan, W 545 billion will be spent during the period on projects with a total value of W 1,120 billion which will be initiated during the period or were already in progress at the beginning. Of this total, approximately W 400 billion (36%) relates to renewal or major maintenance of track, equipment and structures. The principal new works are double tracking of the Honan line (Iri-Songjongri, W 220 billion) and standardization of the Suwon line (Suwon-Inchon, W 110 billion). The Government has agreed under previous loans that substantial changes to the investment plan will only be made with the Bank's concurrence. Project selection procedures are well developed, and EPB approval is required before new projects can be accepted into the plan. The investment plan, and potential new candidate projects, are reviewed by the Bank in the course of supevision of ongoing projects.

G. Tariffs

2.15 KNR's tariffs are uniform throughout the system and are regulated by the Government. Following major upward adjustments of both freight rates (45%) and passenger fares (40%) in 1980, regular annual adjustments have been effected to ensure that rates fully reflect the effect of inflation. According to data produced from KNR's traffic costing system, all major services are operating at or above breakeven on a fully-distributed cost basis, with the notable exception of ordinary passenger train services, which are operated at a substantial loss in furtherance of government's social policies. The effects of this on KNR are discussed more fully in the Financial Analysis at para. 6.03.

III. THE SEOUL-BUSAN CORRIDOR

A. General Economic Situation

3.01 The Seoul-Busan (Gyeongbu) Corridor links the capital city of Seoul to the large industrial areas of the Southeast coast and the port city of Busan. In between, the cities of Daegu and Daejon are the third and fourth largest urban areas of the country after Seoul and Busan. The corridor contains about two-thirds of Korea's population and accounts for over 70% of GNP. Further details of the economic importance of the corridor are in the table below:

PRESENT ECONOMIC ACTIVITIES OF GYEONGBU CORRIDOR (1982)

	Korea	Gyeongbu corridor service area	Gyeongbu corridor in % of country totals
Area (km)	98,997	34,897	35.3
Population (1,000 persons)	39,331	25,896	65.8
Population density (man/km)	397	741	186.7
Manufacturing outputs (billion Won)	43,225	37,374	86.5
G.N.P. (billion Won)	38,437	28,336	73.7
Productivity (1,000 Won/km^2)	388,266	811,979	209.1
Car ownership (in Unit)	646,996	516,192	79.8
Rail passengers (million passenger km)	15,838	8,871	56.0

Note: The figures of G.N.P, Productivity and outputs in manufacturing are in constant 1980 prices.

Source: Review of Long-Term Transport Investment Needs in the Seoul-Busan Corridor and Feasibility Study of a High Speed Rail Line Between Seoul and Busan; Interim Phase II Report for MOT; Berger, KRIHS, Kampsax, Hyundai, March 31, 1984.

3.02 The major objective of the Government's long-term national land use plan is to seek a more balanced and decentralized development on the basis of integrated regional settlement areas. However, two among the three primary growth centers and two among the twelve secondary centers included in the plan are in the Gyeongbu corridor. Even with implementation of the development strategies, the share of population and GNP in the corridor is expected to continue increasing over the next decade.

3.03 The transport network in the corridor displays an hourglass shape with a dense network around Seoul in the North, a narrow neck through the mountainous area between Daejon and Daegu in the center and a wider service area between Daegu and Busan. The spine of the system consists of a double track rail line and a four lane expressway. From Daegu, the expressway splits into two branches going to Busan via Ulsan in the East and Masan in the South. Because of its geographical and topographical characteristics, the corridor is well defined and suitable for high density public transport services (Maps IBRD 13133R1 and 18758).

B. Traffic

3.04 Passenger traffic in the corridor nearly tripled in 11 years from 1971 to 1982. The construction of the expressway in the early 1970s introduced competition for the railway and resulted in the fast development of express bus services; the parallel national highway is used now mainly for shorter trips. The railways responded by upgrading the quality of their service and introducing air conditioned express trains. The table below illustrates the growth rates of various modes and also the shift from ordinary trains to the higher quality express services for which traffic increased over five times during the period.

SEOUL-BUSAN CORRIDOR PASSENGER TRAFFIC 1971-82
(million pkm)

	1971	%	1982	%	82/71 ratio
High Quality Services					
Railroad	1,188	6	9,835	19	8.3
Express bus	3,205	17	12,441	24	3.9
Air	314	2	654	1	2.1
All high quality services	4,707	25	22,930	44	4.9
Other Services					
Railroad ordinary	6,112	32	5,215	10	0.9
Intercity bus	8,395	43	23,716	46	2.8
Total	14,507	75	28,931	56	2.0
Combined High Quality and Other Services					
Railroad	7,300	38	15,050	29	2.1
Highway bus	11,600	60	36,157	70	3.1
Air	314	2	654	1	2.1
All Travel	19,214	100	51,861	100	2.7

Note: Travel by non-commercial modes is excluded.

Source: Ibid, Table para. 3.01

3.05 Freight transport has also increased, albeit at a much slower rate. Tonnage transported by the railways in the corridor increased from 15 to 20 million tons from 1974 to 1983.

C. The Railway Line

3.06 The Gyeongbu line is 445 km long. From Seoul to Suweon, about 30 km, there are four tracks, two of which are electrified and reserved for suburban services. The rest of the line is double tracked and not electrified. To Suweon, the line operates under CTC while from Suweon it is under the Automatic Block System (ABS). The headway allowed by the latter varies between 6.6 and 13.2 minutes depending on the type of trains and other factors.

3.07 Signalling - The present ABS was installed seventeen years ago and the quality of domestic manufacture was not up to international standards at that time. There is still a large number of manually operated switches on the main line. While the system was adequate for the conditions at the time, when

trains were fewer and slower, it has now become old and unreliable; also spare parts are not easy to get. The number of system failures is inordinately high at around 1,000 per year. This is about 10 times more than is considered acceptable on other rail networks. While the number of accidents due to system failures has so far been limited by strict safety precautions, failures disrupt the smooth running of trains and create delays, thus reducing line capacity.

3.08 The length of blocks is presently 2 km, but because of the configuration of the signals, a green light is obtained only when the passing train has travelled two block lengths or 4 km. The capacity of the present system is estimated at some 120 trains per day each way at both ends of the line (excluding the suburban section near Seoul) and 100 trains per day through the mountainous central section.

3.09 Traffic and Operations. Freight and passenger traffic development for the last decade is given in Tables 3.1 to 3.4 and summarized below:

GYEONGBU LINE RAIL TRAFFIC

	1974	1983	Average annual growth rate (%)
Freight			
ton (000's)	15,745	20,075	2.7
ton km (million)	1,883	2,119	1.3
Express Passengers			
passenger (000's)	9,500	37,749	16.6
pkm (million)	1,916	6,914	15.3
Other Passengers			
passenger (000's)	42,148	29,109	-3.7
pkm (million)	2,588	1,348	-6.7
Total Passengers			
Passenger (000's)	51,648	66,858	3.0
pkm (million)	4,504	8,262	7.0

Source: KNR

In 1983, intercity ordinary train service was reduced drastically and the number of passenger km (pkm) fell to only one quarter of its 1982 level. Now the remaining passengers are mostly commuters, particularly between Seoul and Suweon and to a lesser extent around Busan, Daegu and Daejon.

3.10 Traffic on the line is about 73% passenger trains and 27% freight trains. This proportion of passenger trains will increase even further and may reach 85% by the end of the century. Passenger trains' top operating speed is 120 km/hr on the flat sections, and that of freight trains about 85 km/hr. However, the latters' actual average operating speed is as low as 40 to 50 km/hr because of time lost waiting in passing sidings while being overtaken by faster passenger trains. Traffic is rapidly approaching capacity on most sections of the line. With the increasing demand for the better express passenger services, line capacity would be reached in the next few years.

3.11 Tariffs and Costs. The following services are offered in the corridor:

	Time Seoul-Busan	Speed km/hr	Fare Won/pkm
Super-express (Saemaul)	4h45	92	31
Air conditioned express	5h05	83	19
Limited express	5h05	82	14
Ordinary trains	7h00	45	6.8
Express highway bus	5h30	80	13

3.12 The higher class trains provide faster service at higher fares to a few cities, while the ordinary trains stop at more towns and travel at much slower average speeds. While the express trains have proven extremely profitable for KNR, the ordinary trains at controlled low tariffs are losing money (Table below). KNR has begun to reduce the ordinary train services, starting with the Gyeongbu line, in order to make space for the more profitable express trains. Further discussion of this matter is in Chapter VI.

	Operating cost per pkm	Revenue per pkm	Net operating revenue (loss) per pkm
Super express	21.16	31.31	10.16
Air conditioned express	11.71	19.50	7.79
Limited express	10.13	13.65	3.52
Ordinary trains	24.42	6.80	(17.62)

IV. THE PROJECT

A. Project Objectives

4.01 In the fall of 1984, the Government requested Bank assistance in financing the resignalling of the railway line in the Seoul-Busan or Gyeongbu corridor. The proposed project results from the findings of the "Review of Long-term Transport Investment Needs in the Seoul-Busan Corridor", a study financed under the Seventh Railway Project (1836-KO) and prepared by Government and Bank staff assisted by consultants. The project was therein assigned the highest priority, insofar as it makes a significant contribution to the safety of operations, provides increased capacity to the existing line, and postpones other, more costly investments. The project would make a direct contribution to the Government's overall plan for increasing transport capacity in this vital corridor (see para. 3.01), and also gives the Bank the opportunity to pursue our dialogue with the Government and KNR on the institutional strengthening of KNR; multi-modal transport planning; and the longer term investment program which is being planned for this major transport corridor.

B. Project Scope and Description

4.02 The project forms part of a program (KNR's Management Improvement Program) for the development of rail traffic in the Seoul-Busan corridor over the next few years. This program is designed to reduce losses incurred for ordinary train services as well as to improve other already profitable services by decreasing unit cost of services offered. The program comprises: (a) institutional and policy measures aimed mainly at ensuring KNR's long-term viability; (b) measures to improve intermodal complementarity and railway competitiveness; and (c) investments in track signalling to increase capacity and in related rolling stock/equipment in line with transport demand. The proposed loan will include funds to finance investments only for parts of (c) together with associated technical assistance and training. KNR and the Government will fund the other investments.

4.03 Parts (a) and (b) of the program will be implemented during the 1985-88 period. The main steps will include:

(a) In the short term (one to two years)

(i) The further discontinuation of ordinary trains in 1985, (4 were discontinued in 1984, and 22 in 1983). EPB has to approve proposed plan;

(ii) the closure of one uneconomic line and the conversion to private sidings of two others;

(iii) the downgrading of fifteen full service railway stations into "simple stations" which will result in significant reductions in operating costs. Also, the privatization of ticket selling at such stations will lower further staffing costs;

(iv) an increase in the Seoul-Busan Corridor speed from 120 kph to 130 kph, and also in the number of air-conditioned coaches to improve service to passengers;

(v) an increase in passenger train frequency by decreasing train interval from 30 minutes to 20 minutes;

(vi)seeking EPB approval for 1985 tariff increases on freight service and passenger services (5%), and the introduction of flexible (volume dependent) freight tariffs. For the SMESRS service, tariffs were increased by 23.7% on August 18, 1984;

(b) In the longer term (two to five years)

(vii) the formation of joint ventures with publicly held real estate development companies to rebuild 4 major stations (Seoul, Daejon, Daegu and Yongsan) as commercial centers;

(viii) the introduction of bus feeder and car rental services, to enable KNR to provide a more complete service and improve KNR's competitiveness in relation to bus transport;

(ix) marketing container services, pickup and delivery of freight parcels;

(x) further reductions in staff through automatic fare collection system and central traffic control system.

4.04 The project represents part (c) of the program, and would consist of resignalling of the Seoul-Busan double-track line between Suweon and Daegu (approximately 290 km) and installation of a CTC system that would increase capacity to 170 trains per day. Power supply and communication systems would also be supplied as well as train indicators, buildings, supervision and training. Details are given in Annex 3. CTC already exists between Seoul and Suweon where it was installed some years back in connection with opening of suburban services on that part of the line. Between Daegu and Busan the signalling system (ABS) has been recently upgraded and therefore CTC installation can be postponed for a few years. In installing the new system, the block length will be reduced significantly from 2 km to 0.6 km, thus providing substantial capacity increase by enabling shorter distance between trains. Because the existing system is old and substandard, the new system will also be more reliable and safer. In addition, related rolling stock, equipment and material to increase the number of trains in the corridor are part of the project, although to be financed by Government.

4.05 At negotiations, assurances should be sought from Government that it will take all steps necessary to facilitate the implementation of KNR's Management Improvement Program for the Seoul-Busan corridor, and will consult with the Bank from time to time to review and evaluate progress.

C. Cost Estimates and Financing

4.06 Detailed designs are completed for all project works. Quantities were derived from final engineering, and unit prices are based on current world market prices for equipment to be imported. The cost of goods to be procured locally and not to be financed by the Bank was estimated on the basis of current domestic prices, but shadow pricing was used for the economic analysis. An exchange rate of W 860 to the US dollar was used for calculating the US dollar equivalent costs. The estimated project cost, expressed in January 1985 prices and including physical and price contingencies is about US$178.3 million, of which US$64 million represents the cost of equipment to be procured under ICB. A list of items to be financed by the proposed loan is given in Table 4.1. The Government will finance materials and construction costs from its own resources.

4.07 Physical contingencies are included for all project costs: 5% on locally procured goods and civil works, and 1% on imported equipment. Annual price contingencies were applied as follows: for local costs, 2.5% in 1985, 5% in 1986, and 5.5% in 1987 and 1988; for foreign costs, 5% in 1985, 7.5% in 1986, and 8% in 1987 and 1988. Price contingencies represent 11.3% of base cost estimates plus physical contingencies. Summary cost estimates are as follows (detailed estimates are given in Table 4.2):

SUMMARY OF PROJECT COSTS
(in January 1985 prices)

	Local	Foreign	Total	Local	Foreign	Total	Foreign exchange as % of total
	---- (Won billion) ----			---- (US$ million) ----			
Signalling	14.6	37.5	52.1	17.0	43.6	60.6	72
Power supply	2.6	2.9	5.5	3.1	3.3	6.4	52
Communications	7.7	8.1	15.8	8.9	9.5	18.4	52
Equipment rooms	3.7	-	3.7	4.4	-	4.4	-
Supervision	3.3	-	3.3	3.8	-	3.8	-
Coaches	44.0	-	44.0	51.1	-	51.1	-
Materials	8.6	-	8.6	10.0	-	10.0	-
Total Base Cost	84.5	48.5	133.0	98.3	56.4	154.7	36
Physical contingencies	4.2	0.5	4.7	4.9	0.6	5.5	11
Price contingencies	6.9	8.7	15.6	8.1	10.0	18.1	55
Total Project Cost	95.6	57.7	153.3	111.3	67.0	178.3	38

4.08 Terms of the Loan. The loan will be made to GOK, and the proceeds will be onlent to KNR through a subsidiary loan agreement at the same interest rate and terms as the Bank loan. The signing of a subsidiary loan agreement satisfactory to the Bank will be a condition of effectiveness. These arrangements will be confirmed during negotiations.

D. Project Implementation and Procurement

4.09 The project will be implemented by KNR, which has experience of this type of work. About 246 km of the network have already been equipped with a similar CTC signalling system, and these works have been carried out competently, on time, and without cost overruns. The project implementation schedule is shown in Table 4.3. The project is expected to be completed by December 31, 1988, and the Closing Date of the proposed loan would then be June 30, 1989.

4.10 Civil works will not be financed by the Bank. All civil works contracts will be awarded in accordance with the country's procurement procedures, which are satisfactory to the Bank. Procurement of equipment will be subject to International Competitive Bidding (ICB) in accordance with Bank guidelines for procurement, except for a number of small items worth less than US$200,000 per order and totalling less than US$3 million, which would be purchased on the basis of quotations received from three potential sup-

pliers. All packages for equipment above US$100,000 will be subject to the Bank's prior review of procurement documentation. In bid evaluation for equipment contracts to be let through ICB, Korean manufacturers will be allowed a preferential margin of 15% of the CIF cost of competing imports, or the relevant prevailing level of customs duties, whichever is lower. For items not financed by the Bank, Government procurement procedures will apply.

PROCUREMENT PROCEDURES
(US$ millions)

Project element	Procurement Method		Total cost
	ICB	Other	
Civil works	0.0	15.8	15.8
	(0.0)	(0.0)	(0.0)
Equipment and services	64.0	3.0	67.0
	(64.0)	(3.0)	(67.0)
Coaches etc.	0.0	68.0	68.0
	(0.0)	(0.0)	(0.0)
Taxes	0.0	27.5	27.5
	(0.0)	(0.0)	(0.0)
Total	64.0	114.3	178.3
	(64.0)	(3.0)	(67.0)

Note: Figures in parenthesis are the respective amounts financed by the Bank. Figures also include contingencies.

E. Disbursement

4.11 Disbursement of the proposed loan would be as follows:

(a) 100% foreign expenditures of the CIF cost of imported equipment and materials;

(b) 100% local expenditures of the ex-factory cost of locally manufactured equipment and materials;

(c) 100% of the cost of technical assistance and overseas training.

4.12 Domestic transport from port or factory would not be eligible for Bank financing. Any savings under the loan would be cancelled unless otherwise agreed with the Bank. Disbursements against training and contracts for goods and services valued at less than US$50,000 each would be made on the basis of Statements of Expenditures (SOEs). To facilitate disbursements for project expenditures, a revolving fund will be established with an initial deposit of US$6 million, equivalent to about four months of expected expendi-

tures. Documentation supporting the SOEs need not be submitted to the Bank but should be kept in the project office in Seoul and made available for review by the Bank's supervision missions.

4.13 An estimated schedule of disbursements is given in Table 4.4, where a comparison is made with the Bank-wide profile for railway projects. Disbursements are expected to proceed slightly faster than the standard profile, mainly because of the nondiversified nature of the type of equipment to be procured and because of the advanced state of project prepration. The schedule is based on the assumption that the proposed loan would become effective by September 1985.

F. Environment

4.14 No negative impact on the environment is expected from the project. The project will contribute to the Government's efforts to make rail transport an attractive alternative to the use of private cars, therefore minimizing pollution.

V. ECONOMIC EVALUATION

5.01 The corridor running from Seoul to Busan contains two-thirds of the country's population and accounts for three quarters of the country's GNP. It is thus imperative that the transport capacity be increased in pace with transport demand in order not to stifle economic development. Since transport investments are massive and have a long economic life, it is also important that their timing and sequencing be well planned. The project is part of a program (para. 4.02) to increase transport capacity in the corridor both for rail and road transport. The project will permit more intensive use of the existing infrastructure at relatively low cost, thus postponing for some years more expensive major new infrastructure investments.

A. Traffic and Capacity

5.02 Traffic on the line ranges from 110 to 70 trains per day in each direction on respectively the Northern section of the line, between Suweon and Cheonan, and the Southern section from Daejon to Daegu (Table 5.1). The respective line capacities with the present signalling system are 120 and 100 trains per day. Passenger traffic can be grouped by train service type into Super-express (Saemaul, 5% of total passengers), express, both air-conditioned and non airconditioned (74%) and ordinary (21%). For the future, the number of Saemaul trains, 8 to 11 per day depending on the section, and of ordinary trains, 8 to 10 per day, has been assumed constant. Express passenger traffic has been assumed to grow at 7% p.a. and freight traffic at 3%. The resulting number of trains per day has been calculated in Table 5.2. Without the project, capacity on the northern section would be exceeded in 1987 and on the southern section in 1993. With the project, capacity is expected to be increased by about one third, i.e. to 170 trains per day on the northern section and 130 trains per day south of Daejon.

B. Economic Rate of Return

5.03 The present signalling system is in such a state of deterioration that a major overhaul is needed to stop the rapidly increasing failure rate. Without overhaul, the further increase of failure (para. 3.07) would gradually reduce the line capacity by disturbing the schedules of trains and would also have repercussions on other parts of the line. Safety standards, already low by international criteria, would deteriorate seriously. The cost of the needed overhaul is about 80% of the cost of the new system. The balance of 20% is attributable to the centralized traffic control system and block shortening that would permit upgrading the line's capacity by about one-third. The investment required for overhaul and the additional investment for upgrading have been evaluated separately (Tables 5.2 and 5.3). It was possible, however, to postpone for a few years the extension of the system all the way to Busan as some improvements were made a few years ago to the Automatic Train Stop System (ATS) between Daegu and Busan and the capacity increase will not be needed until the early 1990's.

5.04 The project benefits are in terms of consumer surplus. The fact that people are ready to pay more than the bus fare reflects the benefit they derive from express train travel, e.g., comfort, speed, safety, etc. Consequently, the benefits of increasing the capacity for the better passenger services are measured in terms of willingness to pay for the services over and above their costs. They are calculated as the difference between the cost of the services and their revenues, and give an overall return of 41% on the resignalling investment (Tables 5.6). The return on the overhaul part of the project is 39% and the return on the capacity increase part of the project is 47% (Tables 5.4 and 5.5). The estimation is based on the assumption that without the project, express train passengers only would be diverted to road, but it is likely that KNR would in fact reduce the less profitable services first. This likely overestimation is, however, more than balanced by the fact that no account was taken of the increase in productivity of equipment operating at an higher average speed and which will require proportionately less rolling stock to accommodate higher traffic. Hence the operating costs would be reduced, generating additional savings that have not been quantified. Of the increase of productivity, only the staff reduction of about 150 has been accounted for.

C. Sensitivity and Risks

5.05 The main area of risk for this type of project is traffic forecasting. For the purpose of sensitivity analysis, the ERR has been recalculated assuming lower traffic growth rates. Estimated costs for earlier Korean railway projects have typically been realistic, or even on the high side, with funds remaining in previous loans after project execution. For the sensitivity analysis, the ERR's of the capacity-increasing investments have been recalculated with cost variations of ±10%. The impact of the introduction of a high speed train operating on a separate line has been assessed on the basis of a 1996 opening — the most likely date in terms of economic feasibility and practicable construction schedules. Also shown is a theoretical date (1992) at which the investment would be marginal.

Economic Rate of Return	Combined investment %	Overhaul of the line %	Capacity increase %
Base Case (no HST)	41	39	47
Express Passenger Traffic Growth 3% p.a.	31	34	21
Express Passenger Traffic Growth 5% p.a.	36	37	34
Cost + 10%	38	36	45
- 10%	44	42	50
HST operating from 1992	12	11	16
HST operating from 1996	36	34	42

The impact of substantially slower traffic growth rates does reduce the rate of return but it remains acceptable, since benefits are only postponed. The

introduction of the high speed train in 1996 would have minimal effect on the rate of return. Not surprisingly, however, returns are highly sensitive to the date of opening of such a service, though for all practicable dates they remain satisfactory. The risk is therefore very low that the ERR would fall to unacceptable levels.

VI. FINANCIAL ANALYSIS

A. Past Results and Present Financial Position

6.01 Over the last five years [1/] KNR has reported steadily improving financial results, in terms of growth of operating revenue and net income and improvement in its key financial performance ratios. Income statements are at Table 6.2; the salient points are as follows:

	1981	1982	1983	1984
Net Operating Revenue (Won billion)	(5)	19	30	74
Net Income	(63)	(40)	(36)	3
Operating Ratio	101	96	94	87
Rate of Return[a/]	-0.3	1.0	1.4	3.2

a/ Revalued assets.

6.02 This improvement took place during a period in which traffic grew less than 10%. The key factors in KNR's financial performance were:

(a) timely and adequate action on tariffs, which have fully kept pace with inflation [2/] since 1980, when a major increase was effected to bring rates more into line with costs;

(b) tight control over operating costs, which in real terms per-traffic-unit remained constant over the period;

(c) marketing and other measures designed to shift traffic (especially passenger traffic) towards the most profitable services.

6.03 KNR's effort's would have been even more successful had it been able to make more progress in reducing the operating losses on ordinary trains. These services - which operate on main corridors as well as on branch lines - are run at considerably less than cost as a result of government policy requiring the provision of a basic rail transportation service at prices affordable to low income groups. Until 1980, government compensated KNR by retroactive payments which, taking one year with another, covered the full operating loss on the services. Following a substantial increase in tariff

1/ 1984 estimated.

2/ As measured by CPI.

rates in 1980, however, the compensation has been reduced and now approximates the underrecovery of variable operating cost plus half the fixed operating cost distributed to the service. Government intends that KNR should cover the rest of the loss from efficiency improvements and profits on other services. Thus, for example, in 1982 the ordinary trains lost W51.2 billion, of which W35.4 billion was reimbursed by government in 1983 and the balance of W15.8 billion remained as a charge on KNR's other services. KNR's management has already moved to contain the losses to the extent possible, for example by diverting traffic (para. 6.02(c)), reducing the frequency of ordinary trains, and eliminating certain stops. The scope for further such measures is now limited.

6.04 Carrying the residual loss on ordinary trains services has strained KNR's cash flow in recent years. Since 1980, operational cash flow has been barely sufficient to cover debt service - although the trend, like that of profitability, is improving and coverage in 1984 reached 1.2. Most of the capital expenditure of the past four years has been funded by debt, although government has also assisted with modest capital contributions. Principal services of loan funds have been Korea Development Bank (terms averaging about 10% with maturities up to 20 years) and onlending of foreign loans and credits raised by GOK, of which the Bank has been the largest single source. The estimated balance sheet at December 31, 1984 shows a comfortable debt:equity capitalization of 40:60, but liquidity is still tight with a current ratio of only 0.7. Source and use of funds statements and balance sheets for 1981 through 1984 are at Tables 6.3 and 6.4.

B. Future Financial Performance

6.05 Financial projections for KNR through 1990 are at Tables 6.2 - 6.4 and the assumptions on which they are based are described in Table 6.1. They indicate that, with a continuation of present government policies on ordinary trains and with tariff adjustments on other services broadly in line with inflation (although with some detailed adjustments to encourage traffic growth on the most profitable operations), KNR's financial results will maintain the improvement shown in the recent past. Operating revenue should show continued growth throughout the period, representing an overall rate of return between 4 and 5 percent from 1986. However, net income, although positive throughout the period, would decline gradually from 1986 because of increasing interest charges on loan debt. KNR's investments will continue to be funded mainly by debt, although a limited self-financing capability will develop during the period. Government capital contributions are expected to be phased out.

KNR: FINANCING PLAN
(1985-90)

	Won billion		%
Cash flow from operations		1,413	
less working capital	(24)		
debt service	1,248	1,224	
Net cash flow		189	12
Government contributions		100	6
Borrowing		1,330	82
Capital expenditure		1,619	100

6.06 Despite the high percentage of borrowing in the financing plan, the capitalization of KNR will not change significantly over the period because of the growth of equity resulting from the annual revaluation of assets. Debt service can be expected to be adequately covered throughout the period. Under previous loans, KNR has agreed not to incur new long-term debt unless debt service would be covered at least 1.1 times; this agreement is carried forward under the proposed loan.

6.07 The Bank recently agreed with KNR to adopt as the principal indicator of financial performance a rate of return calculated on its commercial services-that is, leaving out of account the losses arising on ordinary passenger trains, which are largely beyond its control. Calculated in this way the target rates are currently:

4% in 1985
5% in 1986
5.5% in 1987
6% in 1988 and thereafter

The financial projections indicate that the targets for the early years will be met, but that later in the decade more substantial tariff action or efficiency gains may be required than have been assumed. This is also suggested by the declining current ratio after 1987. KNR agreed under previous loans to attain a current ratio of 1.5 by the end of 1988, and this agreement will be carried forward. Given the limits of forecasting accuracy, however, the differences from targets are not significant, and do not indicate a need for revision of targets at this stage. KNR's progress will continue to be monitored through project supervision. At the same time, recognizing the desirability of stablizing, and eventually reducing, the cost of improfitable services, Government is to commission a study with consultant inputs, which will examine (a) the effectiveness of ordinary trains in providing the service to low-income travelers required by Government; (b) the possibility of providing this, or alternative, services at lower cost; (c) the scope and

mechanism for compensating KNR for any consequential operating losses; and (d) the significance of those losses for KNR's progress to eventual public corporation status (para. 2.03). When the results of this study (to be completed by the end of 1986) are available, the Bank will review with government and KNR the implications for KNR's financial results and the appropriateness of its performance measurements.

VII. AGREEMENTS REACHED AND RECOMMENDATIONS

7.01 At negotiations, agreement should be reached with the Goverment that it will take all the steps necessary to facilitate the implementation of KNR's Management Improvement plan for the Seoul-Busan corridor, and will consult with the Bank from time to time to review and evaluate progress (para. 4.05).

7.02 Execution of a subsidary loan agreement between the Government and KNR will be a condition of loan effectiveness (para. 4.07).

7.03 Agreement having been reached on the above matters, the project is suitable for a Bank loan of $67 million to the Republic of Korea for a term of 15 years including 3 years of grace, at the standard variable interest rate.

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Past Five-Year Transport Development Plans and Bank's Involvement (1962-81)

1. The First Plan (1962-66) devoted about half of transport investments to modernize and strengthen rail system capacity. Some 275 km of industrial track were built (Tonghae Puku line); the conversion from steam to diesel traction was started with large imports of locomotives and diesel rail cars; the fleet was modernized with large imports of passenger and freight cars while a large number were locally made. The Second Plan (1967-71), in contrast to the First, devoted about 60% of transport investments on highway improvement. Some 655 km of expressways were built (Seoul-Busan, Ulsan-Onyang, Seoul-Incheon and Daejon-Chonju) and the motor vehicles fleet increased by nearly 100,000 units. In the railway sector, 180 km of new tracks were constructed (Kyonggon line), and 50 km doubled-tracked (Honam line); the fleet continued to expand with very large imports of diesel locomotives, passenger and freight cars, while more were built locally and rehabilitated. In the maritime sector, 800,000 GT of ocean-going ships and 130,000 GT of coastal ships were added, while Busan port stevedoring facilities were expanded and Incheon and Ulsan ports were developed to accommodate foreign trade and to establish industrial coastal zones.

2. The Third Plan (1972-76) gave priority to the highway and maritime sectors which receive 47% and 28%, respectively, of transport investments. Some 490 km of two-lane high-speed highways were built (Chonju-Busan, Wonju-Gangreung), a national road maintenance organization was established and the motor vehicles fleet expanded further by 210,000 units. In the maritime sector, expansion of Busan and Mukho ports was started, while Incheon port was developed further with the help of the Asian Development Bank (ADB); the fleet was increased by some 1.3 million GT. In the railway sector, the line capacity increase continued through electrification of 320 km of heavy traffic industrial lines (Chungang, Taebaek and Yongdong), and about 100 km of the Seoul Metropolitan System (SMESRS); about 90 km of new tracks were laid including 9.5 km of the first subway line in Seoul. In the aviation sector, the international airports of Seoul Kimpo, Busan-Kimhae and Cheju were expanded while ten jet liners were imported.

3. The Fourth Plan (1977-81) directed investments at the consolidation of the basic transport infrastructure developed over the previous decade by completing missing links, while also starting to promote better efficiency in the operation of the transport system. The emphasis was placed on expenditures for maintenance and renovations rather than on investments for new facilities, with the major exception being a large-scale subway construction program designed to alleviate urban transport congestion in Seoul City. The basic highway network was completed by widening to 4 lanes the Masan-Busan expressway and constructing the Daegu-Masan 85 km two-lane expressway. A large-scale paving program for national roads was also started to bring the

paved portion to 68%, a target that was not reached partly due to reclassification. In the railway sector, some 160 km of double tracking were completed (Chungbuk and Gyeongbu lines) while large numbers of electric cars, diesel locomotives, passenger and freight cars and workshops were added. In the maritime sector, the first Busan container port and Mukho coal port were completed; and a second expansion of the Busan container area was started. Incheon expansion, started in 1974, was completed in 1978 with the assistance of ADB, through the addition of 20 deep-water berths, including 5 container berths and 4 breakwaters.

4. The past achievements under development plans in the transport sector are very impressive and evidenced by large networks and fleet expansions as well as modernization. However, funds expended under the national plans reflect only part of total investments in the transport sector. Local government investments, including those of provinces, counties, cities and special cities, are not included in the plans unless they are funded at least in part by the central budget. Omitting to take them into account would considerably distort the assessment of the real magnitude of Korea's progress. In particular, the four Special Cities (Seoul, Busan, Daegu and Incheon) road investment programs were not shown in the Fourth Transport Plan although with over W 700 billion at current prices (nearly US$1 billion), 80% of which was in Seoul City, they represented 37% of the country's overall road investment. In comparison, W 880 billion or 46% were spent on national and express highways and W 328 billion or 14% on provincial, county and city roads.

Performance Assessment

5. Broadly, the basic objectives of the transport development plans were met as the network expanded fast enough to accommodate economic growth. The general approach that gave priority to large investments to increase system capacity was the most appropriate. The traffic grew so fast that halfway measures, such as rehabilitation and improvement of the deficient network of the 1960s, would have been insufficient and short-sighted.

6. The highway development policy was geared to develop a network of roads to serve the short and medium distance traffic for which they have an economic advantage over the railways. The Road Plan developed in 1968, in consultation with the Bank, proposed a very ambitious program consisting of: (a) the development through 1986 of a network of about 4,000 km of trunk highways to form a grid of longitudinal and transversal axes linking the four major gate ports of Incheon, Busan, Mogpo and Mukho toward inland centers, and (b) the construction over a 10-year period of a 1,600 km two-lane expressway network designed on separate alignments from the old roads, that could be expanded when traffic volumes would require it. The program was 75% completed and was determinant in localizing industries around Seoul and in most provincial capitals, speeding the urbanization process as the population migrated more easily from rural areas. The voluntary delay in improving the secondary and tertiary networks was justified in view of the highway requirements of the industrialization policy.

7. Similarly, the railway investment policy was directed at strengthening its transport capacity for bulk freight and long distance passenger

traffic where the railways have a comparative advantage. Investment in modernization, double tracking and electrification of the most heavily used freight line (14 million tons p.a.) enabled the railway to perform more efficiently and to cope with demand. In particular, it helped increase express train traffic from 1 billion passenger-km in 1971 to 11 Billion in 1983, to make large profits. However, to keep freight or recover local passenger traffic that would be better handled by road transport, the railway attempted to compete by investing in improvements that were economically not so justified and had to apply a fares policy for ordinary trains that could not cover operating costs. Also the Government forced the railways to invest in infrastructure for other than strictly economic reasons such as double-tracking of the Chung-Buk line.

8. Past investments, geared to the development of ports, including those of Busan, Incheon and Ulsan, were necessary to cope with the large increase of ocean-going freight and to attract heavy industries to coastal areas. Also, the Busan containerization program was effective in reducing handling costs and expediting flows of cargo, although custom clearances still impose lengthy transit delays. However, efforts were too restricted to the major ports. A national port development policy remains to be introduced to shape the future role, number and localization of lesser ports, particularly to support coastal shipping which has scope for much expansion, given the geography and political situation which make Korea a de facto island. Progress in the shipbuilding industry has been very instrumental in modernizing the domestic fleet, which has proven to be a source of foreign exchange earnings. An expansion of air transport was also timely in serving the many foreign and local businessmen who were the artisans of Korea's fantastic exports expansion that increased from 1962 to 1978 at an average of 27% p.a.

The Bank's Involvement

9. The Bank has played an active role in advising and assisting the Korean authorities in pursuing their transport objectives. Since 1962, the Bank Group has assisted the KNR through eight railway projects amounting to US$556 million. The first seven projects have been satisfactorily completed and the eighth was substantially modified to account for slower imports of coal. This project for Coal and Cement Distribution is to strengthen the capacity of the railways, ports and inland terminals to cope with the expected increase in transport of these commodities, resulting partly from large coal imports substituting for oil. Bank-supported investments have concentrated on improved capacity and service for long distance passenger and bulk cargo transport. The Bank has also maintained an active dialogue on the railway's financial situation, investment plans, level and structure of tariffs. After some deterioration in the 1970s, Government agreed to implement a financial recovery plan for KNR as part of the Seventh Railway Project. A revised plan, following the severe downturn of the economy in the early 1980s, was agreed upon.

10. Since 1969, the Bank has financed six highway projects and a pre-investment credit totalling US$695 million which have had a major impact in assisting Government with the improvement and expansion of the national and provincial road networks and with institution-building in the MOC and MOHA.

Significant policy changes, relating to the highway sector, which were effected through the highway projects, include the adoption of more appropriate road standards, revisions of regulations governing vehicle weights and dimensions, and a modified government policy on toll roads. The MOC's organization to maintain the national road network was established and strengthened, as well as that of MOHA now, through the provision of technical assistance and road maintenance equipment. Korean consulting firms have benefitted through their association with foreign consultants on the design of road projects.

11. Substantial assistance has also been extended for port development. In part related to Korea's export drive, ports are seriously congested, particularly at Busan, the biggest port. Containerization was introduced in Busan with the assistance of the Bank under two port projects totalling US$147 million; the Saudi Fund for Development participated with the Bank in the financing of the first Busan Port Project. A third port project designed as a subsector loan is now being considered to further improve container handling capacity at Busan and for supporting other maritime plans.

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Issues in the Transport Sector

A. Planning and Coordination

1. Despite considerable efforts, spatial planning of the transportation system is still hindered by generally inadequate interagency coordination, a comparatively limited expertise in planning and economic appraisal techniques, and in the capacity to undertake appropriate longer-term pre-investment studies. World Bank efforts to provide support and encouragement for these activities are meeting with gradually more success than in the past. Although a study financed under a Transport Credit had recommended in 1970 placing transport planning and coordination in the Economic Planning Board (EPB), a Transport Planning Office was set up instead in the Ministry of Transport (MOT). In 1975, a Transport Coordination Committee (TCC) was set up with the concerned ministries to improve coordination, but in practice, it did not coordinate transport sector investments. More effective mechanisms are being worked out. First, the Budget Bureau, located in EPB, exercises considerable influence on year-to-year transport investment decisions through its budgetary control powers. Further, a Bureau of Project Evaluation, established in 1976 in EPB and spurred by the necessity to cut back the public sector investment program has shown interest in transport planning, although its function is limited to reviewing individual major investment proposals submitted by executing agencies on a piecemeal basis. The Bureau's capability in project analysis has been strengthened under the Bank's 1981 Structural Adjustment Loan. Moreover, a study to integrate highway investment planning between highway agencies has just recommended new mechanisms and criteria for selecting investments in line with economic and social priorities. A similar approach is being discussed for ports.

2. Through various projects, the Bank has supported technical assistance for a range of feasibility and planning studies relating to national transport development, urban transportation needs, and inter-modal alternatives along major traffic axes (such as the Seoul-Busan corridor), in addition to more conventional engineering design work for preparing projects. The record of accomplishment has been good although, in some areas, agencies showed a pattern of slower progress, reflecting in part the difficulties of sectoral planning and transport coordination in the Korean context. The promotion of the local transport consulting industry was quite effective. A Korean Institute is jointly responsible with foreign firms for economic aspects of recent multimodal studies. Korean consultants are assuming the largest share of the design work and are given supervision responsibilities for implementing Bank's railroad, port and road projects. The development of a competent consulting industry in the transport sector is likely to lead to significant import substitution and export of such services.

B. Energy Conservation

3. Energy is a key factor in the development of Korea and the large petroleum imports are a major cause of Korea's balance of payment deficit. Although only 20% of fuel consumption is in the transport sector, the share is expected to increase drastically with motorization. Accordingly, one of the current 5-year transport plan's objectives, supported by the Bank, is to help conserve energy. Efforts are directed at modifying energy consumption patterns by shifting traffic to most fuel efficient modes such as railways and coastal shipping. However, the potential for savings is far from being realized. The Government has recognized the need to focus on institutional responsibility and prepare a coordinated program to increase energy efficiency in each potential areas. The Ministry of Energy and Resources (MOER) as agreed with the Bank, under the recent Highway Sector Project, is responsible for coordinating, managing and monitoring actions for conservation of energy used in the transport sector. Transport agencies concerned have agreed to prepare and submit plans to establish energy conservation policies and goals for the near term. Among those are being considered measures to improve operations and freight consolidation for road, rail and maritime transport services and provide incentives to manufacture technical devices and equipment that are more fuel efficient. MOER will assist in the implementation of these policies, monitor achievements through periodic reviews and establish staff training programs.

C. Pricing and Regulations

4. Pricing policy and the regulatory framework have been a feature of Bank-government dialogue for many years. In the 1970s, emphasis was given to supporting Government's efforts to establish agencies, such as KNR and KMPA on a sound financial basis, with investment programs tied to appropriate tariffs and charges for railways and ports. The role of the Bank has been quite effective, although the priority given to reducing inflation in the past two years has led to some reluctance to raise tariffs - for example for rail - in line with changes in costs. The Bank has also assisted Government in the review of transport and traffic regulation, notably in regard to licensing of common carriers, road vehicle taxation, axle loading and similar issues relating to road transportation. Studies on trucking regulation and road user charges are about completed and will recommend important changes to liberalize licensing and raise taxation on diesel fuel.

KOREA

SEOUL-BUSAN CORRIDOR PROJECTS

Proposed Signalling Project

The proposed signalling project is extensive and includes the elements noted below.

(a) Modernization of the signalling system from Suweon to Tongdaegu on the Kyongbu Line, 285.6 km.

- Provide interlocking and power-operated switches at 43 stations;
- Install single direction ABS between stations of the three-block, four-aspect type and provide for reduced operating headway between following trains;
- Install automatic train stop equipment at all wayside signals.

(b) Provide for remote control (CTC) of interlockings in two and ultimately in three sections.

- Extend the existing Seoul Region CTC control from Suweon to Pyongtaek, a distance of 33.9 km, by an addition to the present panel;
- Daejon Region, Pyongtaek to Tongdaegu, 251.7 km to be controlled from a new panel in Daejon;
- In the future, control Tongdaegu to Busan from a third control center.

(c) Provide computer-aided dispatch facilities for the above CTC systems.

- For the Seoul Region CTC control center including the enhancement of the existing Seoul-Suweon section;
- Daejon Region, Pyongtaek to Tongdaegu.

(d) Provide a supervisory indication panel for the above control centers in KNR headquarters.

(e) Install or improve warning systems at 118 level crossings, Suweon to Tongdaegu.

(f) Install platform train indication and annunciators at nine passenger stations.

(g) Provide a cable communications system for voice and data necessary to support the new signalling system.

(h) Install hot box detectors at three stations.

(i) Install a power distribution system for signalling purposes.

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Selected Documents and Data Available in Project File

1. Technical Specification for Supply of Equipment and Materials for Kyongbu line, KNR, January 1985, 325 pages, plus drawings.

2. Railway Signalling System, KNR, January 1985, 31 pages.

3. Assessment of Proposed Signalling for the Seoul-Busan Corridor Korean National Railroad, Canadian Pacific Consulting Services, Ltd., March, 1985.

4. CTC Project Schedule of Kyongbu Line (Suwon to Tongdaegu). Detailed project cost summary and comparison of costs of signalling overhaul and capacity increase, KNR, December 18, 1984.

5. Revised 5th Five Year Investment Plan of KNR.

6. Quantified evaluation of KNR's Management Improvement Plan (1983-85).

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Growth Trend of Domestic Freight Traffic (1961-82)
(Units: 1,000 tons; million tons-km)

	1961		1966		1962-66	1971		1967-71	1976		1972-76	1981		1977-81	1982	
	Traffic volume	% share	Traffic volume	% share	% increase	Traffic volume	% share	% increase	Traffic volume	% share	% increase	Traffic volume	% share	% increase	Traffic volume	% share
Tonnage																
Railways	15,373	47.9	24,064	46.9	9.4	31,955	25.1	5.8	43,629	17.8	6.4	48,761	12.1	2.2	47,437	11.0
Highways																
Commercial	N/A	-	N/A	-	-	73,934	58.0	-	93,751	38.2	4.9	104,256	26.0	2.1	108,576	25.2
Private & gov't.	N/A	-	N/A	-	-	10,320	8.1	-	94,439	38.4	55.7	226,547	56.4	19.1	247,575	57.6
Subtotal	15,299	47.6	24,528	47.8	9.9	84,254	66.1	28.0	188,190	76.6	174.4	330,803	82.4	11.9	356,151	82.8
Maritime	1,442	4.5	2,686	5.3	13.2	11,263	8.8	33.2	13,829	5.6	4.2	22,206	5.5	9.9	26,454	6.2
Aviation	-	-	-	-	-	7	-	49.1	5	-	(5.7)	18	-	28.5	30	-
Total	32,114	100.0	51,278	100.0	9.8	127,479	100.0	20.0	245,653	100.0	5.2	401,788	100.0	10.3	430,072	100.0
Tons-km																
Railways	3,486	88.2	5,450	81.6	9.3	7,841	48.9	7.5	9,728	44.6	4.4	10,815	37.5	2.2	10,892	36.9
Highways																
Commercial	N/A	-	N/A	-	-	3,302	20.6	-	4,374	20.0	5.8	4,868	16.9	2.2	5,097	17.2
Private & gov't.	N/A	-	N/A	-	-	237	1.5	-	2,172	10.0	55.7	5,217	18.1	19.2	5,674	19.2
Subtotal	323	88.2	558	8.4	11.6	3,539	22.1	44.7	6,546	30.0	13.1	10,085	35.0	9.1	10,771	36.4
Maritime	141	3.6	672	10.0	36.7	4,653	29.0	50.2	5,533	25.4	3.5	7,927	27.5	7.5	7,881	26.7
Aviation	-	-	-	-	-	2	-	-	2	-	(2.5)	7	-	26.5	11	-
Total	3,950	100.0	6,680	100.0	11.1	16,035	100.0	19.1	21,809	100.0	6.4	28,834	100.0	5.8	29,555	100.0

Sources: (1) Fifth Five-Year Economic and Social Development Plan, Transportation Sector Plan (1982-86), December 1981, Transportation Sector Planning Task Force, MOT, Korea, pp. 2-3.
(2) Statistical Yearbook of Transportation - 1981, MOT, Korea, pp. 111, 113, 155, 157.
(3) Statistical Yearbook of Transportation - 1973, MOT, Korea, pp. 76-77, 101.
(4) Statistical Yearbook of Transportation - 1982, MOT, Korea, pp. 10-11, 159, 161.
(5) Mission to Korea.

Table 1.1

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Growth Trend of Domestic Passenger Traffic (1961-82)
(Units: 1,000 passengers; million pass-km)

	1961		1966		1962-66	1971		1967-71	1976		1972-76	1981		1977-81	1982	
	Traffic volume	% share	Traffic volume	% share	% increase	Traffic volume	% share	% increase	Traffic volume	% share	% increase	Traffic volume	% share	% increase	Traffic volume	% share
Passengers																
Railways																
Rail intercity	88,291	13.0	138,299	8.3	9.4	128,159	4.1	(1.5)	148,562	2.8	3.0	268,364	2.9	13.1	282,022	2.9
Seoul suburban	N/A	-	N/A	-	-	N/A	-	-	100,107	1.9	-	172,765	1.9	10.7	161,548	1.6
Subtotal	88,291	13.0	138,299	8.3	9.4	128,159	4.1	(1.5)	248,669	4.7	14.2	441,129	4.8	12.2	443,570	4.5
Subway	-	-	-	-	-	-	-	-	33,914	0.6	-	88,326	1.0	21.1	89,298	0.9
Highways																
Intercity	N/A	-	277,078	16.7	-	339,886	10.7	4.2	651,624	12.2	13.9	910,657	9.9	7.0	978,402	10.0
Urban	N/A	-	1,234,480	74.6	-	2,684,343	85.0	16.8	4,399,359	82.4	10.4	7,772,473	84.2	12.0	8,280,850	84.5
Subtotal	586,864	86.4	1,511,558	91.3	20.8	3,024,229	95.7	14.9	5,050,983	94.6	10.8	8,683,130	94.1	11.4	9,259,252	94.5
Maritime	3,743	0.6	5,909	0.4	9.6	6,371	0.2	1.5	5,994	0.1	(1.2)	9,230	0.1	9.0	9,602	0.1
Aviation	62	-	192	-	25.4	1,105	-	44.8	795	-	(6.8)	1,555	-	14.4	1,844	-
Total	678,960	100.0	1,655,958	100.0	19.5	3,159,864	100.0	13.8	5,340,355	100.0	11.1	9,223,370	100.0	11.5	9,803,566	100.0
Pass-km																
Railways																
Rail intercity	5,372	53.0	8,665	42.5	10.0	8,750	27.1	0.2	12,441	21.2	7.3	16,552	18.2	5.8	15,838	16.5
Seoul suburban	N/A	-	N/A	-	-	N/A	-	-	1,864	3.2	-	4,976	5.4	21.7	5,196	5.5
Subtotal	5,372	53.0	8,665	42.5	10.0	8,750	27.1	0.2	14,305	24.4	10.3	21,528	23.6	8.5	21,034	22.0
Subway	-	-	-	-	-	-	-	-	388	0.7	-	1,258	1.4	26.5	1,309	1.4
Highways																
Intercity	N/A	-	N/A	-	-	11,936	37.0	-	25,030	42.7	16.0	35,559	39.0	7.3	38,211	39.9
Urban	N/A	-	N/A	-	-	10,981	34.1	-	18,369	31.3	10.8	31,756	34.9	11.6	33,899	35.4
Subtotal	4,618	45.5	11,464	56.2	19.9	22,917	71.1	14.9	43,399	74.0	1[illegible].6	67,315	73.9	9.2	72,110	75.3
Maritime	136	1.3	196	1.0	7.6	256	0.8	5.5	249	0.4	(0.6)	480	0.5	14.0	610	0.6
Aviation	18	0.2	55	0.3	25.0	314	1.0	41.7	276	0.5	(2.6)	557	0.6	15.1	654	0.7
Total	10,144	100.0	20,380	100.0	15.0	32,237	100.0	9.6	58,617	100.0	12.7	91,138	100.0	9.2	95,717	100.0

Sources: (1) Fifth Five-Year Economic and Social Development Plan, Transportation Sector Plan (1982-86), December 1981, Transportation Sector Planning Task Force, MOT, Korea, pp. 2-3.
(2) Statistical Yearbook of Transportation - 1981, MOT, Korea, pp. 16-17, 60-63, 110-113.
(3) Statistical Yearbook of Transportation - 1973, MOT, Korea, pp. 76-77.
(4) Statistical Yearbook of Transportation - 1982, MOT, Korea, pp. 8-9.
(5) Mission to Korea.

Table 1.2

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Forecast for Domestic Passenger Transport (1980-86) /a

	1980			1981			1982			1983			1984			1985			1986			1982-86 average growth	1986-80 multiplier
	Volume	% share	% growth	Volume	% share	% growth	Volume	% share	% growth	Volume	% share	% growth	Volume	% share	% growth	Volume	% share	% growth	Volume	% share	% growth		
Passengers ('000)																							
Railways	430,773	5.0	1.7	470,754	5.2	9.3	523,873	5.3	11.3	585,856	5.5	11.8	650,931	5.6	11.1	721,065	5.7	10.8	793,702	5.8	10.1	11.01	1.84
Subways	65,076	0.8	(2.1)	102,200	1.1	57.0	113,515	1.2	11.1	181,405	1.7	59.8	365,905	3.1	100.6	805,555	6.4	121.4	962,140	7.1	19.4	56.59	14.78
Highways	8,039,006	94.1	5.6	8,525,291	93.6	6.0	9,216,447	93.4	8.1	9,954,056	92.7	8.0	10,607,368	91.2	6.6	11,060,434	87.8	4.3	11,863,642	87.0	7.3	6.83	1.48
Maritime	8,580	0.1	8.2	9,006	0.1	5.0	9,329	0.1	3.6	9,772	0.1	4.7	10,253	0.1	4.9	10,826	0.1	5.7	11,441	0.1	5.7	4.90	1.33
Aviation	1,481	-	(18.3)	1,629	-	10.0	1,753	-	7.6	1,941	-	10.7	2,146	-	10.6	2,395	-	11.6	2,672	-	11.6	10.40	1.80
Total	8,544,916	100.0	5.4	9,108,880	100.0	6.6	9,866,917	100.0	8.3	10,733,030	100.0	8.8	11,636,603	100.0	8.4	12,600,275	100.0	8.3	13,633,597	100.0	8.2	8.40	1.60
Pass-km (million)																							
Railways	21,640	24.7	1.2	23,401	24.9	8.1	25,654	25.2	9.6	28,177	25.5	9.8	31,004	25.7	10.0	33,958	25.9	9.5	36,990	26.1	8.9	9.59	1.71
Subways	926	1.1	2.4	1,362	1.4	47.1	1,517	1.5	4.4	2,227	2.0	46.8	4,084	3.4	83.4	8,162	6.2	99.9	9,745	6.9	19.4	48.32	10.52
Highways	64,131	73.1	3.3	68,247	72.6	6.4	73,669	72.3	7.9	74,210	71.5	7.5	84,172	69.8	6.3	87,391	66.8	3.8	93,115	65.9	6.5	6.41	1.45
Maritime	401	0.5	3.9	426	0.5	6.2	443	0.4	4.0	464	0.4	0.7	489	0.4	5.4	516	0.4	5.5	549	0.4	6.4	5.20	1.37
Aviation	528	0.6	(17.0)	587	0.6	11.2	638	0.6	8.7	710	0.6	11.3	788	0.7	11.0	876	0.7	11.2	976	0.7	11.4	10.70	1.85
Total	87,626	100.0	2.6	94,023	100.0	7.3	101,921	100.0	8.4	105,788	100.0	8.7	120,537	100.0	8.8	130,903	100.0	8.6	141,375	100.0	8.0	8.50	1.61

/a Figures in parentheses indicate negative growth.

Source: "Draft" for preparation of Fifth Five-Year Social and Economic Plan (Transport Sector), August 1981, MOT, Korea, p. 17.

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Forecast for Domestic Freight Transport (1980-86) /a

	1980			1981			1982			1983			1984			1985			1986			1982-86 average growth	1986-80 multiplier
	Volume	% share	% growth	Volume	% share	% growth	Volume	% share	% growth	Volume	% share	% growth	Volume	% share	% growth	Volume	% share	% growth	Volume	% share	% growth		
Tons ('000)																							
Railways	49,008.0	28.4	(3.7)	51,225.0	28.1	4.5	53,660.0	27.5	4.8	56,161.0	26.9	4.6	58,916.0	26.3	4.9	61,933.0	25.8	5.1	65,386.0	25.4	5.6	5.00	1.33
Highways	104,526.0	60.3	(26.1)	110,826.0	60.8	6.0	119,573.0	61.4	7.9	129,391.0	62.0	8.2	139,995.0	62.6	8.2	151,495.0	63.1	8.2	163,870.0	63.5	8.2	8.14	1.57
Maritime	19,230.0	11.1	-	20,215.0	11.1	5.1	21,589.0	11.1	6.8	23,174.0	11.1	7.1	24,790.0	11.1	7.2	26,603.0	11.1	7.3	28,537.0	11.1	7.3	7.14	1.48
Aviation	12.8	-	(7.9)	13.4	-	4.7	14.3	-	6.7	15.3	-	7.0	16.4	-	7.2	17.7	-	7.9	19.0	-	7.3	7.23	1.48
Total	172,776.8	100.0	(18.4)/a	182,279.4	100.0	5.5	194,836.0	100.0	6.9	208,691.3	100.0	7.1	223,717.4	100.0	7.2	240,048.7	100.0	7.3	257,812.0	100.0	7.4	7.18	1.49
Tons-km (mln)																							
Railways	10,798.0	46.6	(2.6)	11,267.0	46.3	4.3	11,756.0	45.5	4.3	12,329.0	44.9	4.9	12,930.0	44.3	4.9	13,603.0	43.6	5.1	14,357.0	43.1	5.5	4.97	1.33
Highways	4,920.0	21.2	(36.4)	5,235.0	21.6	6.4	5,780.0	22.3	8.0	6,246.0	22.8	9.4	6,816.0	23.3	9.2	7,461.0	23.9	8.4	8,153.0	24.4	9.3	9.26	1.66
Maritime	7,463.0	32.2	(0.7)	7,815.0	32.1	4.7	8,312.0	32.2	6.4	8,876.0	32.3	6.8	9,480.0	32.4	6.8	10,100.0	32.5	6.9	10,836.0	32.5	7.0	6.75	1.45
Aviation	5.1	-	2.0	5.3	-	3.9	5.8	-	9.4	6.2	-	4.9	6.7	-	8.1	7.5	-	11.9	8.0	-	6.7	8.58	1.57
Total	23,186.1	100.0	(9.3)	24,322.3	100.0	4.9	25,853.8	100.0	6.0	27,457.2	100.0	6.5	29,343.7	100.0	6.5	31,171.5	100.0	6.7	33,354.0	100.0	6.9	6.52	1.44

/a Figures in parentheses indicate negative growth.

Source: "Draft" for preparation of Fifth Five-Year Social and Economic Plan (Transport Sector), August 1981, MOT, Korea, p. 18.

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Comparison of Investment Plans (1977-81 and 1982-86)
(Billion won)

Transport investment	The Fourth Plan (1977-81) /a /c Investment requirements: Domestic capital	Foreign capital (US$ mln)	Total	Composition ratio (%)	The Fifth Plan (1982-86) /b Investment requirements: Domestic capital	Foreign capital (US$ mln)	Total	Composition ratio (%)
Railway	289.9 (719.0)	231.7 (574.6)	402.1 (997.2)	14.5	894.3	715.6	1,330.8	13.4
Highway	1,141.0 (2,829.7)	174.9 (433.8)	1,225.6 (3,039.5)	44.0	3,568.9	245.8	3,718.8	37.4
Road /d	373.1 (925.3)	174.9 (451.2)	457.8 (1,135.3)	16.4	1,175.0	220.8	1,309.7	13.2
Vehicles /e	741.2 (1,838.2)	- (-)	741.2 (1,838.2)	26.6	2,307.6	-	2,307.6	23.2
Others	26.6 (56.0)	- (-)	26.6 (66.0)	1.0	86.3	25.0	101.5	1.0
Ports and ships	557.4 (1,382.4)	902.3 (2,237.7)	994.1 (2,465.4)	35.7	1,693.2	1,576.9	2,655.1	26.7
Ships	358.8 (889.8)	773.6 (1,918.5)	733.3 (1,818.6)	26.3	1,228.6	1,365.2	2,061.4	20.7
Ports and facilities	200.6 (497.5)	128.7 (319.2)	260.8 (646.8)	9.4	464.5	211.7	593.7	6.0
Aviation	51.4 (127.5)	15.5 (38.4)	58.9 (146.1)	2.1	175.4	687.0	594.5	6.0
Subway	54.1 (134.2)	97.0 (240.6)	101.0 (250.5)	3.6	1,324.5	509.8	1,635.0	16.5
Waterway	1.9 (4.7)	- -	1.9 (4.7)	0.1	5.0	-	5.0	-
Total	2,095.7 (5,197.5)	1,421.4 (3,525.1)	2,783.6 (6,903.4)	100.0	7,661.3	3,735.1	9,939.7	100.0
Total capital expenditure	14,188.0 (35,186.2)	10,000.0 (24,800.0)	19,028.0 (47,189.4)		59,000.0	23,673.4	72,100.0	
Total transport investment as % of total capital expenditure	14.8	14.2	14.6		13.0	15.8	13.8	

/a The Fourth Plan figures are in 1975 constant value.

/b The Fifth Plan figures are in 1980 constant value.

/c The figures in parentheses indicate the 1980 constant value.

/d Including construction, repair and loan repayment of national roads only.

/e Including new vehicles additional to the fleet and replacements for scrapped vehicles.

Note: GNP deflator: 1975 = 100, 1980 = 247.9.

Sources: (1) The Fourth Five-Year Economic Development Plan (1977-81), EPB, Korea, 1976, pp. 140-141, 152-153.

(2) The Fifth Five Year Economic and Social Development Plan - Transport Part for Implementation (1982-86), MOT, Korea, October 1981, p. 51.

(3) Transport Part of the Investment Plan, EPB, Korea, October 12, 1981, pp. 8, 17, 26.

Table 2.1

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Korean National Railroad (KNR)

KNR Intercity Passenger Traffic: 1966-84 Actual and 1985/86 Forecast

	Number of passengers (million)				Passenger-km (million)				Average distance (km)			
	Commuter	Long distance /a	Military	Total	Commuter	Long distance /a	Military	Total	Commuter	Long distance /a	Military	Total
Actual												
1966	38.40	98.00	1.90	138.30	830	7,288	546	8,664	21.61	74.37	287.37	62.65
Second FYP												
1967	41.60	108.40	1.90	151.90	883	8,150	543	9,576	21.23	75.18	285.79	63.04
1968	38.70	110.60	1.60	150.90	828	9,280	482	10,590	21.40	83.91	301.25	70.18
1969	37.90	114.80	2.00	154.70	799	9,680	598	11,077	21.08	84.32	299.00	71.60
1970	38.20	91.40	1.70	131.30	854	8,425	539	9,818	22.36	92.18	317.06	74.78
1971	41.40	85.20	1.60	128.20	940	7,300	510	8,750	22.71	85.68	318.75	68.25
Third FYP												
1972	26.30	109.20	1.60	137.10	629	8,914	519	10,062	23.92	81.63	324.38	73.39
1973	22.50	118.90	1.60	143.00	552	9,681	487	10,720	24.53	81.42	304.38	74.97
1974	20.60	117.60	1.60	139.80	481	9,581	471	10,533	23.35	81.47	294.38	75.34
1975	15.10	122.00	1.40	138.50	326	10,626	434	11,386	21.59	87.10	310.00	82.21
1976	17.20	130.10	1.30	148.60	367	11,678	395	12,440	21.34	89.76	303.85	83.71
Fourth FYP												
1977	17.40	143.50	1.30	162.20	380	13,782	401	14,563	21.84	96.04	308.46	89.78
1978	18.20	155.70	1.70	175.60	402	15,670	516	16,588	22.09	100.64	303.53	94.46
1979	19.60	162.10	1.30	183.00	434	16,253	399	17,086	22.14	100.27	306.92	93.37
1980	18.90	164.90	1.20	185.00	428	16,376	400	17,204	22.65	99.31	333.33	92.99
1981	18.00	153.50	1.30	172.80	410	15,740	403	16,553	22.78	102.54	310.00	95.79
Fifth FYP												
1982	17.00	143.30	1.20	161.50	405	15,051	381	15,837	23.82	105.03	317.50	98.06
1983	16.30	136.30	1.00	153.60	400	15,363	310	16,073	24.50	112.66	310.00	104.57
1984	14.60	131.10	1.40	147.10	376	15,190	396	15,962	25.70	115.90	283.10	108.50
Forecast												
1985	15.70	141.60	1.20	158.50	376	16,947	372	17,695	23.95	119.68	310.00	111.64
1986	16.00	148.00	1.20	165.20	383	17,976	372	18,731	23.94	121.46	310.00	113.38

/a See analysis by type of service, Table 2.2.

Source: KNR/Bank.

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Korean National Railroad (KNR)

KNR Long-Distance Intercity Passenger Traffic by Type of Service

1971-84 Actual and 1985/86 Forecast

	Number of passengers (million)							Passenger-km (million)							Average distance (km)						
		Limited express							Limited express							Limited express					
	Spec. exp.	A/C	Non-A/C	Sub-total	Ord. exp.	Ord.	Total	Spec. exp.	A/C	Non-A/C	Sub-total	Ord. exp.	Ord.	Total	Spec. exp.	A/C	Non-A/C	Sub-total	Ord. exp.	Ord.	Total
Actual																					
1971	0.30	-	3.80	3.80	-	81.70	85.80	117	-	1,071	1,071	-	6,112	7,300	390	-	282	282	-	75	85
Third FYP																					
1972	0.40	-	5.90	5.90	-	102.90	109.20	47	-	1,653	1,653	-	7,115	8,915	368	-	280	280	-	69	82
1973	0.50	-	7.60	7.60	-	110.80	118.90	183	-	2,105	2,105	-	7,395	9,681	366	-	277	277	-	67	81
1974	0.60	-	8.80	8.80	4.40	103.80	117.60	234	-	2,224	2,224	940	6,183	9,581	390	-	253	253	214	60	81
1975	0.80	-	11.50	11.50	4.70	104.80	121.80	298	-	2,862	2,862	1,004	6,463	10,627	373	-	249	249	214	62	87
1976	1.30	-	15.00	15.00	5.40	108.30	130.00	465	-	3,673	3,673	1,025	6,516	11,679	358	-	245	245	190	60	90
Fourth FYP																					
1977	1.60	0.40	27.40	27.80	8.50	105.60	143.50	550	122	6,291	6,413	1,357	5,463	13,783	344	305	230	231	160	52	96
1978	1.90	1.60	34.40	36.00	9.40	108.40	155.70	645	461	7,852	8,313	1,287	5,425	15,670	339	288	228	231	137	50	101
1979	2.40	2.00	36.10	38.10	8.70	112.90	162.10	772	530	8,252	8,782	1,207	5,492	16,253	322	265	229	230	139	49	100
1980	2.50	3.00	34.30	37.30	9.00	116.10	164.90	797	727	7,739	8,466	1,230	5,883	16,376	319	242	226	227	137	51	99
1981	2.20	8.80	30.90	39.70	5.30	106.30	153.50	722	2,040	6,793	8,833	616	5,569	15,740	328	232	220	222	116	52	103
Fifth FYP																					
1982	1.90	9.70	33.40	43.10	0.40	97.90	143.30	641	2,210	6,984	9,194	47	5,169	15,051	337	228	209	213	118	53	105
1983	1.90	10.80	37.90	48.70	-	85.90	136.50	607	2,585	7,680	10,265	-	4,491	15,362	319	239	203	211	-	52	113
1984	1.90	13.10	40.70	53.80	-	75.40	131.10	589	3,070	7,947	11,017	-	3,582	15,190	313	234	195	206	-	47	116
Forecast																					
1985	2.00	14.20	42.70	56.90	-	82.70	141.60	653	3,201	8,707	11,908	-	4,386	16,947	327	225	204	209	-	53	120
1986	2.20	16.90	45.70	62.60	-	83.20	148.00	718	3,715	9,131	12,846	-	4,412	17,976	326	220	200	205	-	53	121

Source: KNR/Bank.

Table 2.2

Table 2.3

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Korean National Railroad (KNR)

KNR Seoul Urban (SMESRS) Passenger Traffic

1971-84 Actual and 1985/86 Forecast

	Number of passengers (million)			Passenger-km (million)	Average distance (km)
	Commuter	Noncommuter	Total		
Actual					
1974	5.90	22.70	28.60	545	19.06
1975	17.10	65.30	82.40	1,540	18.69
1976	19.10	80.50	99.60	1,865	18.72
Fourth FYP					
1977	25.90	113.50	139.40	2,536	18.19
1978	38.30	157.10	195.40	3,466	17.74
1979	50.20	190.50	240.70	4,300	17.86
1980	50.00	195.70	245.70	4,436	18.05
1981	56.20	212.50	268.70	5,005	18.63
Fifth FYP					
1982	64.60	217.40	282.00	5,196	18.43
1983	78.00	237.70	315.70	5,615	17.79
1984	87.60	254.30	341.90	5,916	17.30
Forecast					
1985	91.80	286.30	378.10	6,944	18.37
1986	100.20	313.80	414.00	7,604	18.37

Source: KNR/Bank.

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Korean National Railroad (KNR)

KNR Freight Traffic: 1966-84 Actual and 1985/86 Forecast
(Million tons)

	Major commodities							Others					
	Coal	Cement	Ore	Oil	Fertiliser	Grain	Sub-total	General cargo	Private car return	Container	Military	KNR	Total
Actual													
1966	10.50	1.70	1.10	0.90	1.20	1.20	16.60	4.40	-	-	1.10	0.90	24.00
Second FYP													
1967	11.20	2.20	1.40	1.40	1.20	1.30	18.70	5.60	-	-	2.30	0.80	27.40
1968	9.70	3.20	1.70	1.70	1.50	1.60	19.40	5.90	-	-	2.80	1.00	29.10
1969	10.40	4.40	1.70	2.10	1.20	1.40	21.20	5.60	-	-	2.70	1.20	30.70
1970	12.10	4.90	1.80	2.40	1.10	1.30	23.60	5.00	-	-	2.10	1.00	31.70
1971	12.20	5.80	1.60	2.50	1.10	1.40	24.60	4.60	-	-	1.90	0.90	32.00
Third FYP													
1972	11.30	6.00	1.50	2.20	1.30	1.60	23.90	4.60	-	-	2.40	0.70	31.60
1973	13.60	7.50	2.30	2.70	1.50	1.60	29.20	5.50	-	0.20	1.70	1.00	37.60
1974	15.10	7.80	2.90	2.70	1.90	1.30	31.70	5.10	-	0.20	1.30	1.10	39.40
1975	16.70	9.00	3.00	3.10	2.20	1.00	35.00	3.50	1.50	0.20	1.40	1.10	42.70
1976	16.10	10.20	3.40	3.10	1.80	1.30	35.90	3.20	1.60	0.30	1.50	1.30	43.80
Fourth FYP													
1977	17.50	10.30	3.20	3.50	2.10	1.20	37.80	4.60	1.90	0.50	1.50	1.30	47.60
1978	17.90	10.90	3.10	3.80	2.20	1.20	39.10	4.80	2.00	0.60	1.50	1.60	49.60
1979	18.00	11.20	3.40	4.30	2.10	1.10	40.10	4.70	2.00	0.60	1.50	2.00	50.90
1980	18.60	9.80	3.40	3.90	1.70	1.00	38.40	4.80	1.80	0.40	1.40	2.20	49.00
1981	21.40	8.40	3.90	3.20	1.90	0.60	39.40	4.40	1.60	0.50	1.30	1.60	48.80
Fifth FYP													
1982	19.60	9.50	3.90	2.70	1.80	0.60	38.10	4.30	1.50	0.60	1.40	1.50	47.40
1983	20.10	11.10	4.10	2.60	1.60	0.70	40.20	4.90	1.60	0.80	1.40	1.60	50.50
1984	23.20	10.90	4.30	2.90	1.60	0.70	43.60	4.60	1.60	0.80	1.40	1.70	53.70
Forecast													
1985	21.30	12.40	4.20	2.60	1.30	0.70	42.50	5.80	1.70	0.90	1.40	1.40	53.70
1986	22.20	12.90	4.30	2.60	1.30	0.70	44.00	6.00	1.70	1.00	1.40	1.40	55.50
Average distance, 1986	220	215	247	220	275	330	225	285	190	435	285	115	233
Ton-km, 1986	4,884	2,774	1,062	572	358	231	9,900	1,710	323	435	399	161	12,932

Note: Since 1977, general cargo includes slag and gypsum previously included under ore. Slag and gypsum accounted for 0.8 million tons in 1977 and 1.1 million tons in 1979. Return of private cars, mostly oil tankers, are now shown separately from general cargo. KNR charges half the tare weight at Class III freight rate for this traffic.

Source: KNR.

Table 2.5

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Korean National Railroad (KNR)

KNR Traffic Forecasts to 1991

	1986	1991	Growth rate (% p.a.)
Passenger-km			
Saemaeul	718	704	-
Express /a	12,846	17,480	6.4
Ordinary	4,412	4,240	-1.0
Subtotal	17,976	22,424	4.5
SMESRS	7,600	10,600	7.0
Total	25,576	33,024	5.2
Ton-km	12,932	14,250	2.0/b
GRAND TOTAL	38,508	47,274	4.2

/a Based on passenger growth at 8% p.a. and average distance continuing to decrease slightly.

/b Coal flat; cemet +3% p.a.; +4% p.a.; oil +3% p.a.; fertilizer flat; grain flat; general cargo +2% p.a.; containers +5% p.a. and empty containers +3% p.a.

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Gyeongbu Line Passenger Traffic (1974-83)
('000 passengers)

	Saemaeul	Express: A/C Ltd. express	Express: Non-A/C express	Express: Ordinary express	Express: Sub-total	Ordinary	Other	Commuter	Total
Third FYP									
1974	639	-	7,177	2,323	9,500	32,838	1,059	7,612	51,648
1975	825	-	9,246	2,774	12,020	26,900	1,008	3,251	44,004
1976	1,293	-	12,538	3,046	15,584	27,386	918	3,929	49,110
Fourth FYP									
1977	1,566	431	22,651	3,695	26,777	23,809	926	4,005	57,083
1978	1,901	1,638	28,498	3,768	33,904	24,106	1,011	4,473	65,395
1979	2,324	1,720	30,479	2,978	35,177	25,281	963	4,985	68,730
1980	2,420	2,248	28,967	3,245	34,460	27,072	973	4,640	69,565
1981	2,184	7,032	23,735	3,472	34,239	36,376	979	4,620	68,398
Fifth FYP									
1982	1,911	8,024	24,987	236	33,247	25,080	958	4,543	65,739
1983	1,837	9,158	28,591	-	37,749	21,997	789	4,486	66,858
1984									
1985									
1986									

Source: KNR. Statistical Year Book, 1983.

Table 3.1

Table 3.2

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Gyeongbu Line Passenger Traffic (1974-83)
(mln passenger km)

	Saemaeul	Express				Ordinary	Other	Commuter	Total
		A/C Ltd. express	Non-A/C express	Ordinary express	Sub-total				
Third FYP									
1974	234	-	1,580	336	1,916	2,094	132	128	4,504
1975	294	-	2,029	371	2,400	2,132	254	85	5,165
1976	442	-	2,691	387	3,078	2,106	241	98	5,965
Fourth FYP									
1977	522	122	4,524	355	5,001	1,600	254	111	7,488
1978	612	461	5,589	295	6,345	1,558	261	129	8,905
1979	732	466	6,003	187	6,656	1,608	269	145	9,410
1980	756	530	5,634	208	6,372	1,791	272	134	9,325
1981	677	1,543	4,439	223	6,205	1,790	275	135	9,082
Fifth FYP									
1982	599	1,769	4,400	12	6,181	1,686	264	140	8,870
1983	560	2,107	4,807	-	6,914	422	217	149	8,262
1984									
1985									
1986									

Note: This railway line in 444.5 km long and has 79 stations; the average distance between two stations is 5.63 km.

Source: KNR, Statistical Yearbook, 1983.

Table 3.3

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Gyeongbu Line Passenger Traffic (1974-83)
average distance (km/pas.)

	Saemaeul	Express				Ordi-nary	Other	Commuter	Total
		A/C Ltd. express	Non-A/C express	Ordinary express	Sub-total				
Third FYP									
1974	366.20	-	220.15	144.64	201.68	63.77	124.65	16.82	87.21
1975	356.36	-	219.45	133.74	199.67	79.26	251.98	26.15	117.38
1976	341.84	-	214.63	127.05	197.51	76.90	262.53	24.94	121.46
Fourth FYP									
1977	333.33	283.06	199.73	96.08	186.76	67.20	274.30	27.72	131.18
1978	321.94	281.44	196.12	78.29	187.15	64.63	258.16	28.84	136.17
1979	314.97	270.93	196.96	62.79	189.21	63.61	279.34	29.09	136.91
1980	312.40	235.77	194.50	64.10	184.91	66.16	279.55	28.88	134.05
1981	309.98	219.43	187.02	64.23	181.23	67.86	280.90	29.22	132.78
Fifth FYP									
1982	313.45	220.46	176.09	50.85	185.91	67.22	275.57	30.82	134.93
1983	304.84	230.07	168.13	-	183.16	19.18	275.03	33.21	123.58
1984									
1985									
1986									

Source: KNR, Statistical Yearbook, 1983.

Table 3.4

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Gyeongbu Line Freight Traffic (1974-83)

	Total ton-km (million)	Total tons ('000)	Average distance (km/ton)
Third FYP			
1974	1,883	15,747	119.58
1975	1,750	15,938	109.80
1976	1,714	16,689	102.70
Fourth FYP			
1977	1,928	18,592	103.70
1978	1,996	19,384	102.97
1979	2,042	20,492	99.65
1980	1,984	20,177	98.33
1981	2,009	19,465	103.21
Fifth FYP			
1982	1,953	18,829	103.72
1983	2,119	20,075	105.55
1984			
1985			
1986			

Source: KNR, Statistical Yearbook, 1983.

KOREA

SEOUL - BUSAN CORRIDOR PROJECT

Signalling Component: List of Goods

(Won million, April 1985 prices)

V5LISTODS

	1985			1986			1987			1988			Total		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
Signalling															
Control Center	-	-	-	-	-	-	-	-	-	685	15507	16192	685	15507	16192
Interlockings	1252	1412	2664	2339	2610	4949	2049	2388	4437	-	-	-	5640	6409	12050
Automatic Block System (ABS)	-	-	-	1819	5202	7020	1116	3663	4779	-	-	-	2935	8865	11800
Automatic Train Stop (ATS)	44	241	285	97	562	658	94	539	633	-	-	-	235	1342	1576
Level Crossings	36	49	85	232	381	613	61	108	168	-	-	-	329	538	867
Hot Box Detectors	2	192	195	2	192	195	2	192	195	-	-	-	7	577	584
Train Information System	15	195	210	36	584	620	63	864	927	-	-	-	114	1643	1756
Miscelleaneous	729	67	796	2061	149	2210	1630	283	1913	266	2096	2363	4686	2595	7282
Signalling Total	2078	2157	4235	6587	9679	16266	5015	8036	13051	952	17603	18555	14632	37475	52107
Power Supply															
Substations	111	147	259	15	55	69	68	48	116	-	-	-	194	250	444
Distribution	-	-	-	1557	960	2517	467	460	925	-	-	-	2022	1419	3442
Station Equipment	-	-	-	259	506	765	143	113	256	-	-	-	402	619	1021
Scada System	-	-	-	-	-	-	-	-	-	34	578	612	34	578	612
Power Supply Total	111	147	259	1831	1520	3351	676	621	1297	34	578	612	2652	2867	5519
Communications System															
Carrier System	-	-	-	249	1319	1569	206	582	788	-	-	-	455	1901	2356
Cable System	-	-	-	5035	3351	8386	2102	1604	3706	-	-	-	7137	4955	12092
Dispatchers Phones	-	-	-	-	-	-	-	-	-	90	1278	1368	90	1278	1368
Communications Total	-	-	-	5284	4671	9955	2308	2186	4494	90	1278	1368	7682	8135	15816
Equipment Rooms	782	-	782	865	-	865	1274	-	1274	833	-	833	3754	0	3754
Supervision	661	-	661	882	-	882	882	-	882	882	-	882	3306	0	3306
GRAND TOTAL	3633	2304	5937	15448	15870	31318	10154	10843	20997	2790	19459	22249	32025	48476	80501

Source: KNR and mission estimates.

04.29.85

TABLE 4.1

KOREA

SEOUL - BUSAN CORRIDOR PROJECT

Composition and Cost Estimates

WOYEONG	1985			1986			1987			1988			Total			Total		
	(Won billion)															(US$ (million)		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
1. Signalling	2.08	2.16	4.23	6.59	9.68	16.27	5.02	8.04	13.05	0.95	17.60	18.56	14.63	37.48	52.11	17.01	43.58	60.59
2. Power Supply	0.11	0.15	0.26	1.83	1.52	3.35	0.68	0.62	1.30	0.03	0.58	0.61	2.65	2.87	5.52	3.08	3.33	6.42
3. Communications	-	-	0.00	5.28	4.67	9.96	2.31	2.19	4.49	0.09	1.28	1.37	7.68	8.13	15.82	8.93	9.46	18.39
4. Equipment Rooms	0.78	-	0.78	0.87	-	0.87	1.27	-	1.27	0.83	-	0.83	3.75	0.00	3.75	4.36	0.00	4.36
5. Supervision	0.66	-	0.66	0.88	-	0.88	0.88	-	0.88	0.88	-	0.88	3.30	0.00	3.30	3.84	0.00	3.84
sub-total	3.63	2.30	5.94	15.45	15.87	31.32	10.15	10.84	21.00	2.79	19.46	22.25	32.02	48.48	80.50	37.24	56.37	93.61
5. Coaches	12.55	-	12.55	10.47	-	10.47	10.47	-	10.47	10.47	-	10.47	43.95	-	43.95	51.10	-	51.10
6. Materials, etc.	2.52	-	2.52	2.02	-	2.02	2.02	-	2.02	2.02	-	2.02	8.57	-	8.57	9.96	-	9.96
total	18.70	2.30	21.01	27.93	15.87	43.80	22.63	10.84	33.48	15.27	19.46	34.73	84.54	48.48	133.02	98.30	56.37	154.67
Phys. Conting.	0.94	0.02	0.96	1.40	0.16	1.56	1.13	0.11	1.24	0.76	0.19	0.96	4.23	0.48	4.71	4.92	0.56	5.48
Baseline Estimate	19.64	2.33	21.97	29.33	16.03	45.36	23.77	10.95	34.72	16.03	19.65	35.69	88.77	48.96	137.73	103.22	56.93	160.15
Price Conting.																		
% per year	2.50	5.00	-	5.00	7.50	-	5.50	8.00	-	5.50	8.00	-	-	-	-	-	-	-
% compounded	1.25	2.50	-	5.0625	8.9375	-	10.58469	17.39	-	16.66685	26.7812	-	7.79	17.68	11.31	7.79	17.68	11.31
amount	0.25	0.06	0.30	1.48	1.43	2.92	2.52	1.90	4.42	2.67	5.26	7.94	6.92	8.66	15.58	8.04	10.07	18.11
Total Project Cost	19.89	2.39	22.27	30.81	17.46	48.27	26.28	12.85	39.14	18.71	24.92	43.62	95.69	57.62	153.31	111.26	67.00	178.26

Sources: KNR and mission estimates.
Exchange rate: US$1.00 = Won 860
Physical contingencies: local = 5%, foreign = 1%.

Notes: Custom duties of Won 20.75 billion are included in items 1 to 4 above.
Value Added Tax of Won 2.68 billion is included in items 1 to 6 above.

04.29.85

TABLE 4.2

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Implementation Schedule

Table 4.3

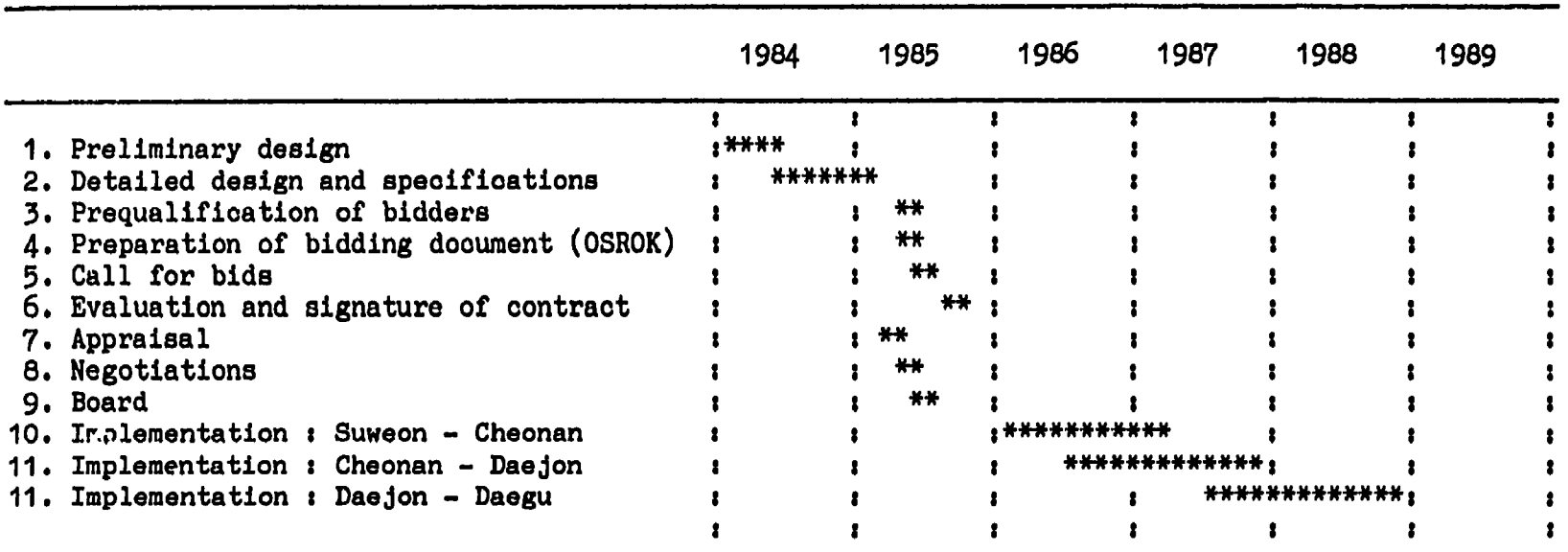


Table 4.4

KOREA

SEOUL-BUSAN CORRIDOR

Cumulative Disbursement Schedule /a

IBRD fiscal year and semester	Estimated disbursements US$ mln	cum	%	Cumulative disbursement profile for Korea
FY86				
I	-	-	-	0.8
II	2.8	2.8	4.2	5.5
FY87				
I	10.1	12.9	19.2	14.0
II	10.2	23.1	34.5	26.1
FY88				
I	7.4	30.5	45.5	40.4
II	7.5	38.0	56.7	55.1
FY89				
I	14.5	52.5	78.4	68.2
II	14.5	67.0	100.0	78.9
FY90				
I				87.0
II				93.0
FY91				
I				97.1
II				100.0

/a Assumptions: Board date in fourth quarter FY85.
Proposed Closing Date: June 30, 1989.

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Number of Trains per day on Kyeongbu Line by Section and Forecast for 1986-96
(Number of trains as of end of 1984)

Section	Passenger						Freight	Total 1984	All types of trains		
	Saemaeul	Exp.	Lt. exp.	Ord.	Baggage	Total			1986	1992	1996
Seoul-Suweon	22	42	80	14	6	164	48	212	264	388	498
Suweon-Cheonan	22	42	80	14	6	164	54	218	264	404	516
Cheonan-Chochiweon	22	38	66	10	6	142	56	198	252	286	492
Chochiweon-Daejon	22	38	68	10	6	144	52	196			
Daejon-Kimcheon	16	32	34	12	4	98	38	136	186	288	366
Kimcheon-Dongdaegu	16	32	26	20	4	108	38	146	204	316	406
Dongdaegu-Samrangjin	12	54	36	12	4	118	25	143	162	246	312
Samrangjin-Busan	12	44	36	20	4	116	25	141			

Source: KNR (February 1985) and Seoul-Busan Transport Corridor Study, 1984. Train numbers are in both directions, excluding SMERS.

Table 5.1

Table 3.2

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Traffic Projection and Train Line C acity with and without Signalling Overhaul

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Section Suwon-Cheonan													
Traffic													
Express Passenger													
Growth rate (%)	7	7	7	7	7	7	7	7	7	7	7	7	7
Passenger (mil)	13.02	13.93	14.91	15.95	17.07	18.26	19.54	20.91	22.37	23.94	25.61	27.41	29.32
Freight													
Growth rate (%)	3	3	3	3	3	3	3	3	3	3	3	3	3
Tons (mil)	4.92	5.07	5.22	5.38	5.54	5.70	5.87	6.05	6.25	6.42	6.61	6.81	7.01
Trains per day													
Seasonal	11	11	11	11	11	11	11	11	11	11	11	11	11
Ordinary & bag.	10	10	10	10	10	10	10	10	10	10	10	10	10
Freight	27	28	29	29	30	31	32	33	34	35	36	37	38
Subtotal	48	49	50	50	51	52	53	54	55	56	57	58	59
Express	61	65	70	75	80	86	92	98	105	112	120	128	137
Total	109	114	119	125	131	138	145	152	160	168	177	187	197
Line Capacity with Project Overhaul	120	120	120	120	120	120	120	120	120	120	120	120	120
Line Capacity without Overhaul	120	114	108	103	96	89	83	74	67	60	54	49	45
Diverted Traffic without overhaul													
Excess Train	-11	0	11	17	24	31	37	46	53	60	66	71	75
Diverted pkm (mil)	0	0	271	404	570	736	879	1092	1258	1425	1567	1686	1781
Unit Benefit (W/pkm)	6	6	6	6	6	6	6	6	6	6	6	6	6
Total Benefit (mil W)	0	0	1626	2422	3419	4416	5271	6553	7551	8548	9403	10115	10685
Section Cheonan-Daejon													
Traffic													
Express Passenger													
Growth rate (%)	7	7	7	7	7	7	7	7	7	7	7	7	7
Passenger (mil)	11.32	12.11	12.96	13.87	14.84	15.88	16.99	18.18	19.45	20.81	22.27	23.83	25.49
Freight													
Growth rate (%)	3	3	3	3	3	3	3	3	3	3	3	3	3
Tons.(mil)	4.95	5.08	5.23	5.39	5.55	5.72	5.89	6.06	6.25	6.43	6.63	6.82	7.03
Trains per day													
Seasonal	11	11	11	11	11	11	11	11	11	11	11	11	11
Ordinary & bag.	8	8	8	8	8	8	8	8	8	8	8	8	8
Freight	27	28	29	30	30	31	32	33	34	35	36	37	39
Subtotal	46	47	48	49	49	50	51	52	53	54	55	56	58
Express	53	57	61	65	69	74	80	85	91	97	104	112	119
Total	99	104	108	113	119	125	131	137	144	152	160	168	177
Line Capacity with Project Overhaul	120	120	120	120	120	120	120	120	120	120	120	120	120
Line Capacity without Overhaul	120	114	108	103	96	89	83	74	67	60	54	49	45
Diverted Traffic without Overhaul													
Excess Train	-21	-10	0	10	23	31	37	46	53	60	66	71	75
Diverted pkm (mil)	0	0	0	311	682	923	1101	1369	1578	1786	1965	2113	2232
Unit Benefit (W/pkm)	6	6	6	6	6	6	6	6	6	6	6	6	6
Total Benefit (mil W)	0	0	0	1869	4089	5536	6608	8215	9465	10716	11787	12680	13394
Section Daejon-Dongdaegu													
Traffic													
Express Passenger													
Growth rate (%)	7	7	7	7	7	7	7	7	7	7	7	7	7
Passenger (mil)	6.33	6.77	7.25	7.75	8.30	8.88	9.50	10.16	10.88	11.64	12.45	13.32	14.26
Freight													
Growth rate (%)	3	3	3	3	3	3	3	3	3	3	3	3	3
Tons (mil)	3.38	3.48	3.59	3.69	3.80	3.92	4.04	4.16	4.28	4.41	4.54	4.68	4.82
Trains per day													
Seasonal	8	8	8	8	8	8	8	8	8	8	8	8	8
Ordinary & bag	10	10	10	10	10	10	10	10	10	10	10	10	10
Freight	19	19	20	20	21	21	22	23	23	24	25	26	26
Subtotal	37	37	38	38	39	39	40	41	41	42	43	44	44
Express	34	36	39	42	45	48	51	55	58	63	67	72	77
Total	71	73	77	80	85	87	91	95	100	105	110	115	121
Line Capacity with Project Overhaul	100	100	100	100	100	100	100	100	100	100	100	100	100
Line Capacity without Overhaul	100	95	90	85	80	76	69	62	56	50	45	41	40
Diverted Traffic without Overhaul													
Excess Train	-29	-22	-13	-5	3	11	22	33	44	50	55	59	60
Diverted pkm	0	0	0	0	204	697	1323	1999	2622	2988	3286	3525	3585
Unit Benefit (W/pkm)	6	6	6	6	6	6	6	6	6	6	6	6	6
Total Benefit (mil W)	0	0	0	0	1226	4003	7940	11968	15735	17926	19719	21153	21511
Overall Benefit	0	0	1626	4291	8734	13955	19819	26737	32751	37190	40909	43948	45591

Table 3.1

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Traffic Projection and Train Line Capacity with Capacity Increase vs. Overhaul

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Section Suseon-Cheonan													
Traffic													
Express Passenger													
Growth rate (%)	7	7	7	7	7	7	7	7	7	7	7	7	7
Passenger (mil)	13.02	13.93	14.91	15.95	17.07	18.26	19.54	20.91	22.37	23.94	25.61	27.41	29.32
Freight													
Growth rate (%)	3	3	3	3	3	3	3	3	3	3	3	3	3
Tons (mil)	4.92	5.07	5.22	5.38	5.54	5.70	5.87	6.05	6.23	6.42	6.61	6.81	7.01
Trains per day													
Seoemul	11	11	11	11	11	11	11	11	11	11	11	11	11
Ordinary & bag.	10	10	10	10	10	10	10	10	10	10	10	10	10
Freight	27	28	29	29	30	31	32	33	34	35	36	37	38
Subtotal	48	49	50	50	51	52	53	54	55	56	57	58	59
Express	61	65	70	75	80	86	92	98	105	112	120	128	137
Total	109	114	119	125	131	138	145	152	160	168	177	187	197
Diverted Traffic Without Overhaul													
Capacity-Trains/day	120	120	120	120	120	120	120	120	120	120	120	120	120
Excess Train	-11	-6	-1	5	11	18	25	32	40	48	57	67	77
Diverted pkm (mil)	0	0	0	122	268	422	586	761	948	1146	1358	1583	1823
Unit Benefit (W/pkm)	6	6	6	6	6	6	6	6	6	6	6	6	6
Total Benefit (mil W)	0	0	0	735	1606	2532	3519	4569	5687	6878	8146	9497	10937
Section Cheonan-Daejon													
Traffic													
Express Passenger													
Growth rate (%)	7	7	7	7	7	7	7	7	7	7	7	7	7
Passenger (mil)	11.32	12.11	12.96	13.87	14.84	15.88	16.99	18.18	19.45	20.81	22.27	23.83	25.49
Freight													
Growth rate (%)	3	3	3	3	3	3	3	3	3	3	3	3	3
Tons (mil)	4.95	5.08	5.25	5.39	5.55	5.72	5.89	6.06	6.25	6.43	6.63	6.82	7.03
Trains per day													
Seoemul	11	11	11	11	11	11	11	11	11	11	11	11	11
Ordinary & bag.	8	8	8	8	8	8	8	8	8	8	8	8	8
Freight	27	28	29	30	30	31	32	33	34	35	36	37	39
Subtotal	46	47	48	49	49	50	51	52	53	54	55	56	58
Express	53	57	61	65	69	74	80	85	91	97	104	112	119
Total	99	104	108	113	119	125	131	137	144	152	160	168	177
Diverted Traffic Without Overhaul													
Capacity-Trains/day	120	120	120	120	120	120	120	120	120	120	120	120	120
Excess Train	-21	-16	-12	-7	-1	5	11	17	24	32	40	48	57
Diverted pkm (mil)	0	0	0	0	0	139	322	517	724	944	1178	1428	1694
Unit Benefit (W/pkm)	6	6	6	6	6	6	6	6	6	6	6	6	6
Total Benefit (mil W)	0	0	0	0	0	834	1932	3099	4342	5664	7071	8569	10165
Section Daejon-Dongdaegu													
Traffic													
Express Passenger													
Growth rate (%)	7	7	7	7	7	7	7	7	7	7	7	7	7
Passenger (mil)	6.33	6.77	7.25	7.75	8.30	8.88	9.50	10.16	10.88	11.64	12.45	13.32	14.26
Freight													
Growth rate (%)	3	3	3	3	3	3	3	3	3	3	3	3	3
Tons (mil)	3.38	3.48	3.59	3.69	3.80	3.92	4.04	4.16	4.28	4.41	4.54	4.68	4.82
Trains per day													
Seoemul	8	8	8	8	8	8	8	8	8	8	8	8	8
Ordinary & bag	10	10	10	10	10	10	10	10	10	10	10	10	10
Freight	19	19	20	20	21	21	22	23	23	24	25	26	26
Subtotal	37	37	38	38	39	39	40	41	41	42	43	44	44
Express	34	36	39	42	45	48	51	55	58	63	67	72	77
Total	71	73	77	80	85	87	91	95	100	105	110	115	121
Diverted Traffic Without Overhaul													
Capacity-Trains/day	100	100	100	100	100	100	100	100	100	100	100	100	100
Excess Train	-29	-27	-25	-20	-17	-13	-9	-5	0	5	10	15	21
Diverted pkm	0	0	0	0	0	0	0	0	0	280	587	909	1254
Unit Benefit (W/pkm)	6	6	6	6	6	6	6	6	6	6	6	6	6
Total Benefit (mil W)	0	0	0	0	0	0	0	0	0	1678	3517	5454	7526
Overall Benefit	0	0	0	735	1606	3367	5451	7668	10029	14220	18784	23520	28627

Table 5.4

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Costs-Benefits Analysis for Signalling Overhaul Between Suweon-Daegu

	Costs	Benefits					
		Suweon-Cheonan	Cheonan-Daejon	Daejon-Dongdaegu	Staff Saving	Total Benefits	Net Benefits
1985	3192					0	-3192
1986	18296					0	-18296
1987	12378	2422	1869			4291	-8087
1988	17104	3419	4089	1226		8734	-8370
1989	1360	4416	5536	4003		13955	12595
1990	1360	5271	6608	7940		19819	18459
1991	1360	6553	8215	11968		26736	25376
1992	1360	7551	9465	15735		32751	31391
1993	1360	8548	10716	17926		37190	35830
1994	1360	8548	11787	19719		40054	38694
1995	1360	8548	12680	21153		42381	41021
1996	1360	8548	12680	21511		42739	41379
1997	1360	8548	12680	21511		42739	41379
1998	1360	8548	12680	21511		42739	41379
1999	1360	8548	12680	21511		42739	41379
2000	1360	8548	12680	21511		42739	41379
2001	1360	8548	12680	21511		42739	41379
2002	1360	8548	12680	21511		42739	41379
2003	1360	8548	12680	21511		42739	41379
2004	1360	8548	12680	21511		42739	41379
2005	1360	8548	12680	21511		42739	41379
2006	1360	8548	12680	21511		42739	41379
2007	1360	8548	12680	21511		42739	41379
2008	1360	8548	12680	21511		42739	41379

Rate of Return (With 7% passenger growth rate) 38.91%

Note: Costs are estimated at 80% of total project costs.

Sensitivity analysis:

Rate of Return:

With 6% passenger growth rate	37.95%
With 5% passenger growth rate	36.98%
With costs +10%	36.30%
With costs -10%	41.98%
With high speed train operating from 1992	11.43%
With high speed train operating from 1996	34.21%

Table 5.5

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Costs-Benefits Analysis for Capacity Increase Between Suweon-Daegu

		Benefits					
	Costs	Suweon-Cheonan	Cheonan-Daejon	Daejon-Dongdaegu	Staff Saving	Total Benefits	Net Benefits
1985	798					0	-798
1986	4574					0	-4574
1987	3094	735				735	-2359
1988	4276	1606				1606	-2670
1989	340	2532	834		600	3966	3626
1990	340	3519	1932		900	6351	6011
1991	340	4569	3099		900	8568	8228
1992	340	5687	4342		900	10929	10589
1993	340	6878	5664	1678	900	15120	14780
1994	340	6878	7071	3507	900	18356	18016
1995	340	6878	8569	5454	900	21801	21461
1996	340	6878	8569	7526	900	23873	23533
1997	340	6878	8569	7526	900	23873	23533
1998	340	6878	8569	7526	900	23873	23533
1999	340	6878	8569	7526	900	23873	23533
2000	340	6878	8569	7526	900	23873	23533
2001	340	6878	8569	7526	900	23873	23533
2002	340	6878	8569	7526	900	23873	23533
2003	340	6878	8569	7526	900	23873	23533
2004	340	6878	8569	7526	900	23873	23533
2005	340	6878	8569	7526	900	23873	23533
2006	340	6878	8569	7526	900	23873	23533
2007	340	6878	8569	7526	900	23873	23533
2008	340	6878	8569	7526	900	23873	23533

Rate of Return (With 7% passenger growth rate) 47.35%

Note: Costs are estimated at 20% of total project costs.

Sensitivity analysis:

Rate of Return:

With 6% passenger growth rate	40.62%
With 5% passenger growth rate	34.00%
With costs +10%	44.83%
With costs -10%	50.29%
With high speed train operating from 1992	16.14%
With high speed train operating from 1996	42.13%

Table 5.6

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

Costs-Benefits Analysis for Signalling Overhaul and Capacity Increase Between Suweon-Daegu

		Benefits					
	Costs	Suweon-Cheonan	Cheonan-Daejon	Daejon-Dongdaegu	Staff Saving	Total Benefits	Net Benefits
1985	3990					0	-3990
1986	22870					0	-22870
1987	15470	3157	1869			5026	-10444
1988	21380	5025	4089	1226		10340	-11040
1989	1700	6949	6371	4003	600	17923	16223
1990	1700	8790	8540	7940	900	26170	24470
1991	1700	11122	11314	11968	900	35304	33604
1992	1700	13238	13807	15735	900	43680	41980
1993	1700	15426	16380	19605	900	52311	50611
1994	1700	15426	18858	23226	900	58410	56710
1995	1700	15426	21249	26607	900	64182	62482
1996	1700	15426	21249	29037	900	66612	64912
1997	1700	15426	21249	29037	900	66612	64912
1998	1700	15426	21249	29037	900	66612	64912
1999	1700	15426	21249	29037	900	66612	64912
2000	1700	15426	21249	29037	900	66612	64912
2001	1700	15426	21249	29037	900	66612	64912
2002	1700	15426	21249	29037	900	66612	64912
2003	1700	15426	21249	29037	900	66612	64912
2004	1700	15426	21249	29037	900	66612	64912
2005	1700	15426	21249	29037	900	66612	64912
2006	1700	15426	21249	29037	900	66612	64912
2007	1700	15426	21249	29037	900	66612	64912
2008	1700	15426	21249	29037	900	66612	64912

Rate of Return (With 7% passenger growth rate) 41.02%

Note: Costs are estimated at 100% of total project costs.

Sensitivity analysis:

Rate of Return:

With 6% passenger growth rate	38.59%
With 5% passenger growth rate	36.30%
With costs +10%	38.44%
With costs -10%	44.04%
With high speed train operating from 1992	12.47%
With high speed train operating from 1996	36.10%

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

KOREA NATIONAL RAILROAD

Assumption for the Financial Projections

General

1. Inflation at the following rates (percent):

CY:	85	86	87	88	89	90
	2.5	5.0	5.5	5.5	5.5	5.5

Income Statement

2. Traffic Projections as described in paras. 2.12-13 and Table 2.5.

3. Tariffs:

   (a) Special express trains: no change;

   (b) Air conditioned limited express trains: decrease of 3% p.a. from 1986 to improve competitive position with air conditioned buses and non-airconditioned trains;

   (c) Ordinary trains: 10% p.a. increase in rates through 1986; thereafter, the loss on the service will be held at not more than 50% of fully distributed fixed costs, either by futher tariff increases or government subsidies or both; and

   (d) All other services: rate increases in line with assumed inflation.

4. Operating Cost:

   (a) Labor: productivity per employee is assumed to increase by 5% p.a. through 1986, 2% thereafter.

   (b) Energy: based on 1983 actual average cost per km for the various types of motive stock.

(c) Maintenance: proportional to traffic growth.

(d) Overheads: at 10% of total direct working cost comprising labor, energy and maintenance.

Source & Use of Funds

5. Government Capital Contributions to cease after 1986.

6. Borrowing at 10%, with 15 year maturities.

7. Capital Expenditures from KNR's investment program through 1986, mission estimates thereafter.

Balance Sheet

8. Deferred charges represents unrealized exchange losses and has been left at its actual value as of December 31, 1983.

9. Net Fixed Assets have been revalued according to the inflation indices set out at para. 1.

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

KOREA NATIONAL RAILROAD

Income Statements
(Years ended December 31)

	Actual			Est.	Forecast					
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Traffic (million traffic units)	32.4	31.8	33.3	35.1	37.1	38.5	40.5	41.8	43.2	44.6
Operating revenue (billion won)	357	452	506	580	619	680	729	789	853	922
Operating cost	362	433	476	506	527	529	585	630	689	753
Net Operating Revenue	(5)	19	30	74	92	151	144	159	164	169
Net nonoperating revenue	2	11	6	6	7	7	8	9	11	12
Interest charges	60	70	72	77	85	89	115	148	157	172
Net Income	(63)	(40)	(36)	3	14	69	37	20	18	9
Operating ratio	101	96	94	87	85	79	80	80	81	82
Rate of return - overall	-0.3	1.0	1.4	3.2	3.9	5.8	4.9	4.9	4.5	4.3
Rate of return - commercial services					4.5	6.5	5.5	5.5	5.1	4.8

Table 6.2

KOREA

SEOUL-BUSAN CORRIDOR PROJECT

KOREA NATIONAL RAILROAD

Source and Use of Funds
(Won billion)

Years ended December 31	Actual 1981	1982	1983	Est. 1984	Forecast 1985	1986	1987	1988	1989	1990
Sources										
Net operating revenues	(5)	19	30	74	92	151	144	159	164	169
Depreciation and other noncash expense	47	55	61	65	67	71	77	82	89	94
Nonoperating revenue	2	11	6	6	7	7	8	9	11	12
Sale of assets	11	12	21	-	-	-	-	-	-	-
Total Internal Funds	55	97	118	145	166	229	229	250	264	275
Borrowing	122	170	121	130	213	193	218	273	228	205
Government capital contributions	23	18	28	14	-	100	-	-	-	-
Total Sources	200	285	267	289	379	522	447	523	492	480
Uses										
Capital expenditures	138	156	144	155	186	274	253	306	300	300
Debt service	96	112	115	121	177	182	169	255	221	244
Change in net working capital (excl. cash)	(32)	11	3	13	(46)	1	38	(53)	43	(8)
Total Uses	202	279	262	289	317	457	460	508	564	536
Net cash flow	(2)	6	5	-	62	65	(13)	15	(72)	(56)
Opening cash balance	10	8	14	19	19	81	146	133	148	76
Closing cash balance	8	14	19	19	81	146	133	148	76	20
Debt service cover	0.6	0.9	1.0	1.2	0.9	1.3	1.3	1.1	1.2	1.1

Table 6.4

KOREA

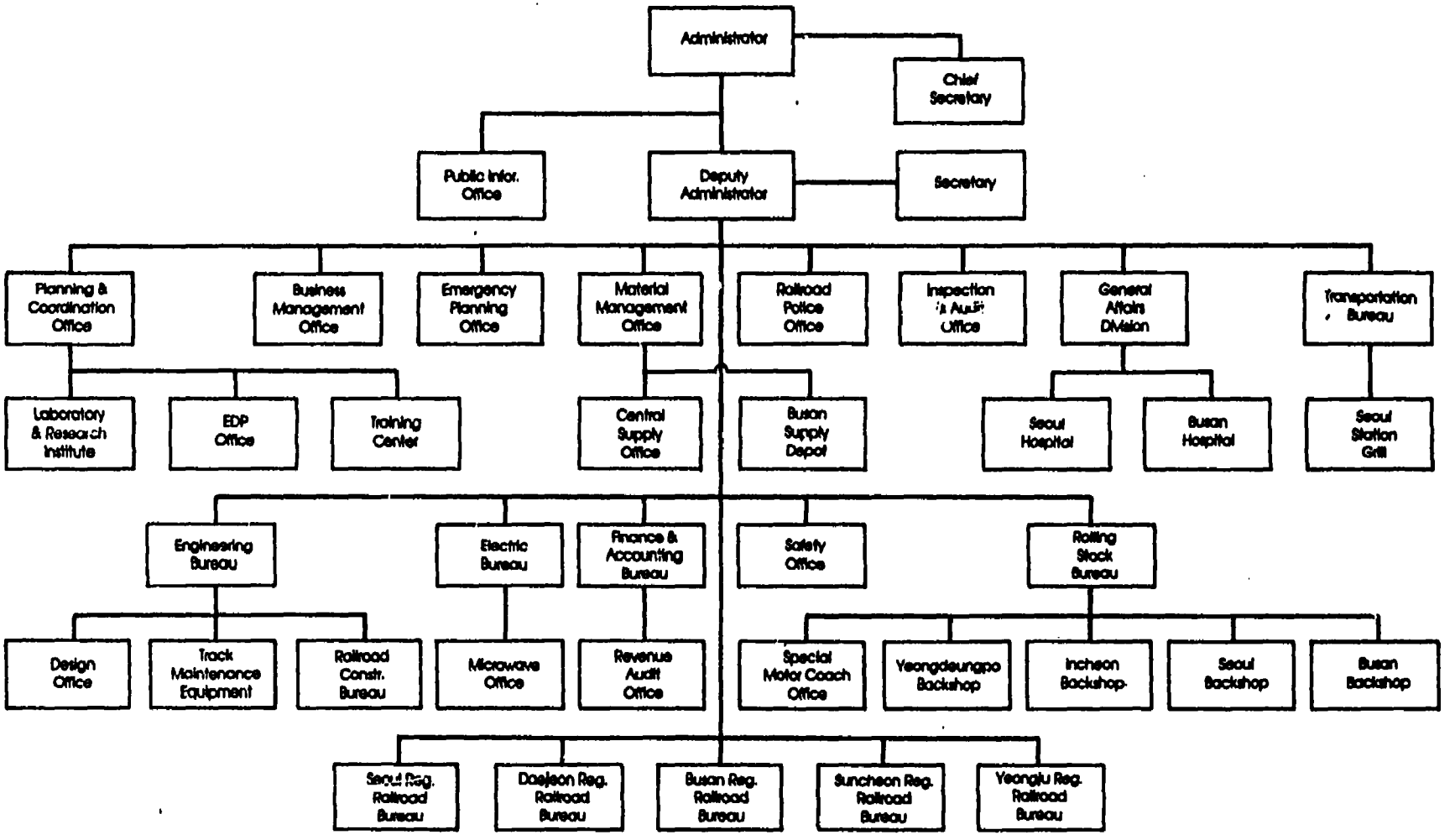
SEOUL-BUSAN CORRIDOR PROJECT

KOREA NATIONAL RAILROAD

Balance Sheets at December 31
(Won billion)

	Actual			Est.	Forecast					
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
ASSETS										
Current Assets										
Cash	8	14	19	19	81	146	133	148	76	20
Accounts receivable	14	17	20	22	25	28	28	29	30	31
Inventory	28	33	32	44	46	48	50	51	53	55
Other	4	7	7	8	9	10	10	11	11	11
Total Current Assets	54	71	78	93	161	232	226	255	201	165
Fixed Assets										
Net fixed assets in use	1,748	2,064	2,246	2,349	2,524	2,841	3,141	3,543	3,848	4,177
Construction w-i-p	113	133	156	207	211	222	255	250	350	450
Total Fixed Assets	1,861	2,197	2,402	2,556	2,735	3,063	3,396	3,793	4,198	4,627
Deferred charges and other assets	70	68	64	64	64	64	64	64	64	64
TOTAL ASSETS	1,985	2,336	2,544	2,713	2,960	3,359	3,681	4,096	4,432	4,808
LIABILITIES										
Current liabilities	135	135	134	137	189	193	158	214	174	195
Long-term debt	704	842	926	1,012	1,132	1,232	1,397	1,562	1,727	1,860
Equity										
Government investment	197	215	226	241	241	341	341	341	341	341
Revaluation reserve	1,077	1,302	1,421	1,484	1,543	1,669	1,825	1,998	2,193	2,405
Retained earnings	(128)	(158)	(163)	(160)	(147)	(78)	(41)	(21)	(3)	6
Total Equity	1,146	1,359	1,484	1,565	1,637	1,932	2,125	2,318	2,531	2,752
TOTAL LIABILITIES	1,985	2,336	2,544	2,713	2,960	3,359	3,681	4,096	4,432	4,808
Current ratio	0.4	0.5	0.6	0.7	0.9	1.2	1.4	1.1	1.0	0.9
Debt:Equity	38:62	38:62	38:62	39:61	41:59	39:61	40:60	40:60	40:60	40:60

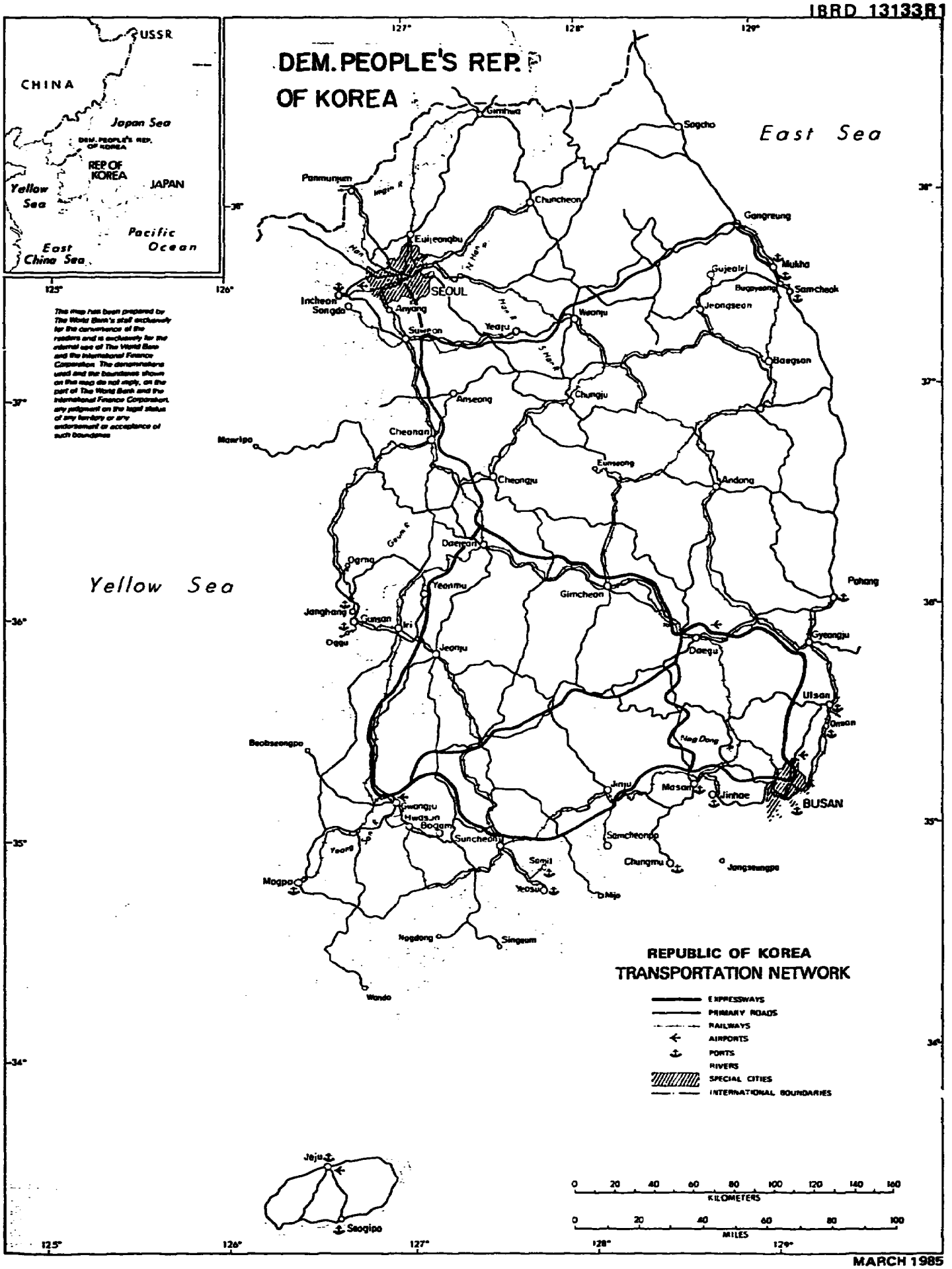
KOREA
TRANSPORT SECTOR
Actual KNR Functional Organization



Source: KNR

World Bank—24503

Chart 1


DEM. PEOPLE'S REP. OF KOREA
East Sea
Yellow Sea
USSR
CHINA
Japan Sea
DEM. PEOPLE'S REP. OF KOREA
REP OF KOREA
JAPAN
Yellow Sea
Pacific Ocean
East China Sea
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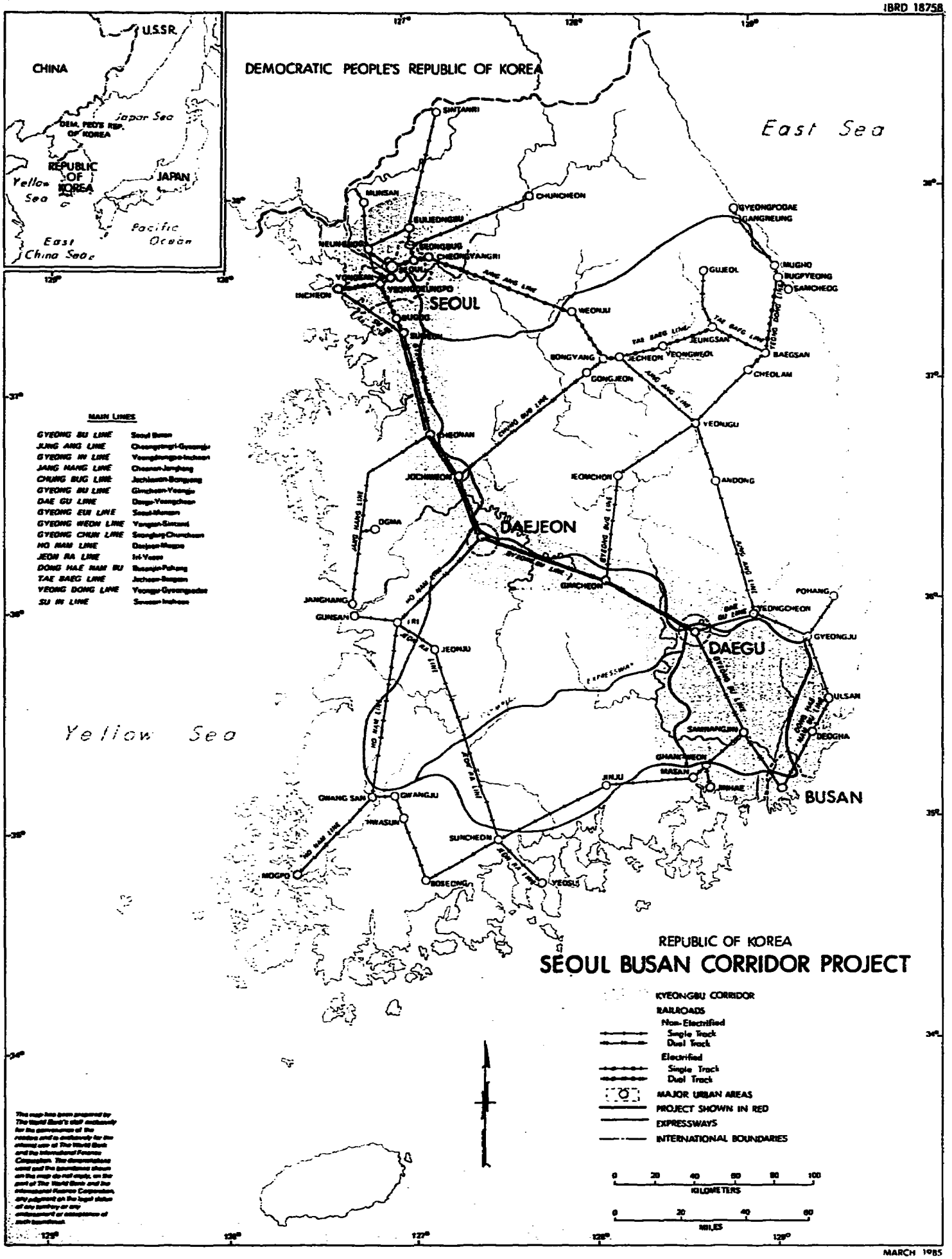
Gamhwa
Sogcho
Panmunjom
Imjin R.
Chuncheon
Gangneung
Euijeongbu
N. Han R.
Mukho
Gujeok
Bugyeong
Samcheok
SEOUL
Incheon
Songdo
Anyang
Han R.
Jeongseon
Weonju
Suweon
Yeoju
S. Han R.
Baegson
Anseong
Chungju
Mawipo
Cheonan
Eumseong
Andong
Cheongju
Daejeon
Geum R.
Ogmo
Yeonmu
Gimcheon
Pohang
Janghang
Gunsan
Iri
Ogpo
Jeonju
Daegu
Gyeongju
Ulsan
Omsan
Nag Dong
Beobseongpo
Jinju
Masan
Jinhae
BUSAN
Gwangju
Hwasun
Bogam
Suncheon
Yeong R.
Samcheonpo
Chungmu
Jangseungpo
Sumjin R.
Yeosu
Mokpo
Mijo
Nogdong
Simgeum
Wando
Jeju
Seogipo
REPUBLIC OF KOREA
TRANSPORTATION NETWORK
EXPRESSWAYS
PRIMARY ROADS
RAILWAYS
AIRPORTS
PORTS
RIVERS
SPECIAL CITIES
INTERNATIONAL BOUNDARIES
0 20 40 60 80 100 120 140 160
KILOMETERS
0 20 40 60 80 100
MILES
125°
126°
127°
128°
129°
38°
37°
36°
35°
34°

MARCH 1985

IBRD 18758



MAIN LINES

GYEONG SU LINE	Seoul-Busan
JUNG ANG LINE	Chaeryeongni-Gyeongju
GYEONG IN LINE	Yeongdeungpo-Incheon
JANG HANG LINE	Cheonan-Janghang
CHUNG BUG LINE	Jochiwon-Bongyang
GYEONG BU LINE	Gimcheon-Yeongju
DAE GU LINE	Daegu-Yeongcheon
GYEONG EUI LINE	Seoul-Munsan
GYEONG WEON LINE	Yeongju-Samrangjin
GYEONG CHUN LINE	Seoungbuk-Chunchoen
HO NAM LINE	Daejeon-Mogpo
JEON RA LINE	Iri-Yeosu
DONG HAE NAM BU	Busanjin-Pohang
TAE BAEG LINE	Jecheon-Bongam
YEONG DONG LINE	Yeongju-Gyeongpodae
SU IN LINE	Suwon-Incheon

REPUBLIC OF KOREA

SEOUL BUSAN CORRIDOR PROJECT

KYEONGBU CORRIDOR

RAILROADS

Non-Electrified
- Single Track
- Dual Track

Electrified
- Single Track
- Dual Track

MAJOR URBAN AREAS

PROJECT SHOWN IN RED

EXPRESSWAYS

INTERNATIONAL BOUNDARIES

0 20 40 60 80 100
KILOMETERS

0 20 40 60
MILES

MARCH 1985